

cinefex

number 3
\$3.50



cinefex

...the journal of cinematic illusions

editor & publisher
Don Shay

associate editor
S.S. Wilson

circulation manager
JoDyne Duncan

editorial consultant
Robert P. Everett

editorial services
Ann Dredla

CINEFEX 3 — December 1980. Published quarterly at P.O. Box 20027, Riverside, California 92516. Subscriptions: four issues — \$12; ten issues — \$25. Foreign: four issues — \$15 surface; \$19 airmail. Return postage must accompany all unsolicited manuscripts, photos, or other materials. Printed by R.B. Graphics, Riverside, California; typesetting by Creative Concepts, Riverside, California; color separations by Vivicolour, Covina, California. Contents copyright © 1980 by Don Shay. All rights reserved. Reproduction in whole or in part without permission is prohibited.

Tauntauns, Walkers and Probots 4

Employing a variety of techniques, ranging from vintage Willis O'Brien-type setups to modern motion control technology, the special effects wizards at Industrial Light and Magic produced a dazzling array of stop-motion wonders for *The Empire Strikes Back*. Effects director of photography Dennis Muren, stop-motion animator Phil Tippett, art director Joe Johnston, and other key members of the ILM effects unit discuss the complex animation sequences from start to finish. *Article by Paul Mandell.*

Walter Murch — Making Beaches Out of Grains of Sand 42

Some of the most significant recent developments in motion pictures involve not what is seen, but rather what is heard. Academy Award-winner Walter Murch, the virtuoso whose work figures prominently in some of the pivotal films of our time, discusses the subtle, psychological, mostly invisible art of sound — from the recording of a single isolated audio track to the monumental mixing of a hundred or more at once. *Article by Jordan Fox.*

The Microcosmic World of Ken Middleham 58

Phase IV was anything but a typical science fiction film. No spaceships, no alien invaders, no unleashed technological horrors — just ants. But not ordinary ants. Ants with geometric patterns emblazoned on their foreheads; ants unafraid to engage a praying mantis in battle; ants that bestow ceremonial honors on their fallen dead; and ants that transport crystals of poisonous material in a suicidal death march. Ace macrocinematographer Ken Middleham discusses the creation and photography of these uncharacteristic ant behaviors. *Interview by Don Shay.*

FRONT COVER — Luke Skywalker astride his Tauntaun in *The Empire Strikes Back*.
An Imperial probe droid from *The Empire Strikes Back* — BACK COVER.

Dennis Muren
Phil Tippett
Joe Johnston
Doug Beswick
Tom St. Amand
Sam Comstock
Ken Ralston
Mike Fulmer

TAUNTAUNS WALKERS & PROBOTS

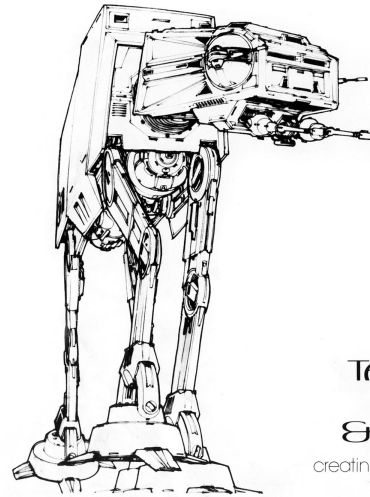
creating stop-motion magic for 'The Empire Strikes Back'

article by
Paul Mandell

"George Lucas wasn't too fond of stop-motion animation before the chess sequence in *Star Wars*," revealed Dennis Muren, effects director of photography for *The Empire Strikes Back*. "He felt that in the films he'd seen the results didn't look real, and the technique wouldn't work for some of the ideas he had in mind." Later, when *Empire* evolved, Lucas was determined to have a full stop-motion department at Industrial Light and Magic.

The irony is blatant but, as Dennis Muren will tell you, George Lucas' initial response was typical. Stop-motion animation is the only special effect that seems to sustain a love/hate relationship with critics and producers. It is the one technique that is appreciated and despised with equal fervor — there is virtually no middle ground. Remarked one technician at ILM: "There was one review out where someone actually made the remark that the tauntaun was a jumpy version of a Ray Harryhausen-type creature! It's incredible because exactly the opposite is true." Still in all, speeders and TIE fighters are accepted without hesitation, but a hybrid animal galloping across an alien tundra evokes a peculiar sense of awe, like a gasp that gets caught in one's throat. Interestingly, the process has remained immune to high technology, oblivious to the credibility factor that motion control hardware can provide. The makers of *Empire* sought to erase that barrier, and did.

Ray Harryhausen and Willis O'Brien had always used dimensional animation as their films' *raison d'être*, and while there is nothing reprehensible about that approach, the *Empire* illusionists saw things differently. Rather than relying on stop-motion to carry the superstructure, the process was treated as a way to provide story points and spectacular vistas. Animation fans may rhapsodize over the tauntaun and snow walker shots, but *Empire* animator Phil Tippett remains staunchly pragmatic about it. "Stop-motion was just one technique — one of many that worked well under certain situations. It just depends on what the intention of the filmmaker is. In Lucas' case, it was to propel the story forward. The technique was applied to the situation and not just used for its own sake. That's how all the stop-motion shots were approached." For all its animated virtuosity, the



Dennis Muren
Phil Tippett
Joe Johnston
Doug Beswick
Tom St. Amand
Sam Comstock
Ken Ralston
Mike Fulmer

TAUNTAUNS
WALKERS
& PROBOTS

creating stop-motion magic for
'The Empire Strikes Back'

frenetic pace of the snow walker sequence was generated solely by rapid cutting, peripheral speeder elements, rotoscoped laser effects and pyrotechnics. And the tauntaun was literally a vehicle for the two main characters — no more, no less. In that sense, it speaks well for the intention of the animators that their work integrates itself effortlessly without pointing to technique.

Oddly enough, rumor had it that George Lucas approached Ray Harryhausen early in the game to mastermind the animation sequences for *Empire*. The news sounded sketchy — almost incredible, in fact — considering Harryhausen was already embroiled in preproduction for *Clash of the Titans* and was way behind schedule. Nonetheless, there was a kernel of truth to the report, as revealed by Phil Tippett. “Lucas approached him about doing some work on it. They went out to lunch and discussed it. Because of their schedules, they couldn’t get together on it.” Dennis Muren offered additional insight into the matter. “I believe that meeting happened in the early part of 1978. Thing is, I don’t think they ever expected Ray to actually take the job. George and Gary really wanted to meet Ray, and that was sort of a way to do it.”

Despite the Harryhausen meeting, Jon Berg and Phil Tippett became Lucas’ prime consideration for executing all the stop-motion effects for *Empire*. The animated oddities cooked up by this team for the chess sequence in *Star Wars* had been sheer throwaway, a fluke that developed when Berg and Tippett presented Lucas and Kurtz with small sculptures as design ideas for additional cantina creatures. No one was more exuberant than Lucas over the reception of the chess sequence, inspiring him to consider more serious applications of the process for the next episode. (Lucas’ early reluctance seems even more ironic when one considers that his first attempt at filmmaking as a teenager contained a sequence in which a pile of plates was made to disappear from a kitchen table frame by frame, much to his delight.)

Though the encore employment of Berg and Tippett would presumably involve the snow walker and tauntaun shots, no one was certain about what technique would be used to realize those sequences during the months that preceded the spring of 1978. “The feeling at the time,” recalled Muren, “was that if the walker or taun shots would resort to another technique, then other stop-motion work would have been dreamed up for Jon and Phil, just to get the department going and experiment with new ideas. My first contacts on the film probably occurred in April 1978. We had the first meetings with George and Gary and Irv Kershner in May or June. I believe Jon and Phil were brought into the project at that time.”

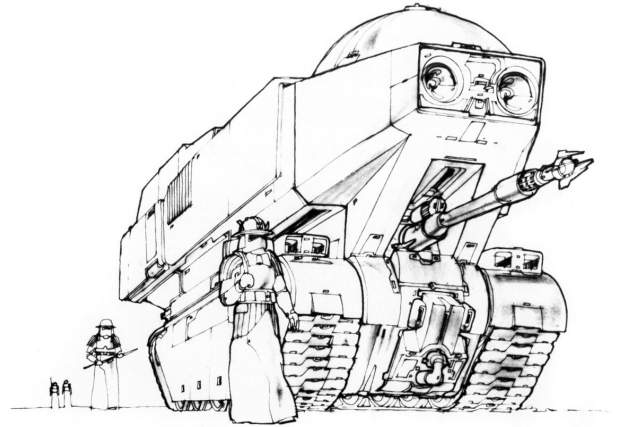
With pay scales arranged and contracts signed, the migration began from Los Angeles to San Rafael, where ground was being broken for the new Industrial Light and Magic. Unlike the old facility, which had been converted from an abandoned warehouse in Van Nuys under the baton of John Dykstra, the *Empire* headquarters had to be built from scratch. Less than twenty of the original ILM team were retained; half were placed in key staff positions. Richard Edlund, who shared the *Star Wars* motion control work with Dennis Muren, advanced to a supervisory position which entailed the overseeing of the building and monitoring the work of the various departments. Edlund’s primary task was to design and build a sophisticated beam splitter printer for compositing the awesome network of elements, and to design and construct the Empireflex motion control camera and its high-speed sister camera. Muren’s responsibilities consisted of shepherding the entire stop-motion operation, designing lighting plans, and supervising and co-filming the space sequences. Joe

Johnston resumed his position as effects art director, and Peter Kuran, assistant to the late Adam Beckett, took charge of the rotoscope department. Finally, Jon Berg and Phil Tippett, who had previously toiled in their own garages and in a small space cordoned off from one of the old ILM stages, were given a fullfledged stop-motion department in which to develop new equipment and ideas.

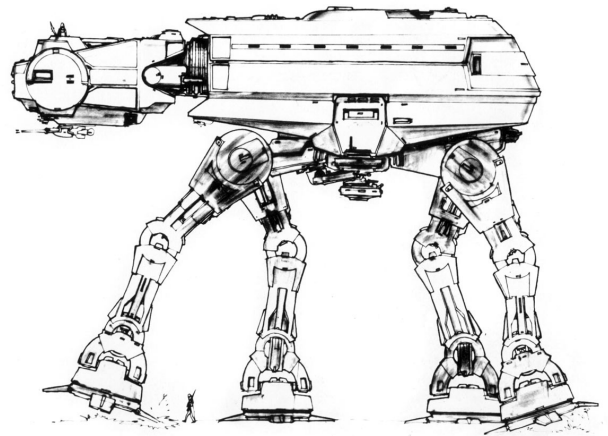
Because of the unusual requirements on the craft end of the animation model work, additional expertise was enlisted. Tom St. Amand had been tooling superior ball-socket armatures for Dave Allen's *The Primevals* when preproduction ground to a halt in July 1978 due to cash flow problems. St. Amand's capabilities were vital to the realization of the walker and tauntaun armatures. Ken Ralston was animating a lizard man and Dave Carson had been sculpting a dinosaur for that same picture when the shutdown occurred. Ralston, a veteran of *Star Wars*, was hired by the *Empire* team as an animator and effects cameraman; Carson joined the ILM model shop. "We'd worked together successfully before," said Muren. "We all worked for years together at Cascade Pictures. So the communication was there. When you can get a group of people who can work in harmony and speak the same language, it's great."

Setting up shop was hardly a picnic. Muren recalled the raw beginnings: "When we arrived, the ILM building was still under construction. Walls were being set, equipment was being shipped up from Los Angeles, storyboards were being redone, and the script was in its final stages. There was no electricity in the building. Although we moved up there in September, we couldn't even turn on a stage light until February! We only had regular work lights. That was a long time. And we only had two cameras up until August of 1979 to shoot with — the Dykstraflex and the old Technirama. When we finally got the Empireflex working, we started the stop-motion work. I think it took eight months to complete the facility."

Complicating matters were several disasters on the regular production which extended themselves into the stop-motion operation. Aside from a brutal fire on an EMI soundstage and the demise of production designer John Barry, the crew filming the



A major battle on the ice planet Hoth was an early feature of *The Empire Strikes Back* script. Design consultant Ralph McQuarrie designed the two-seater armored snowspeeder used by the rebel forces, while design of the Imperial assault vehicles fell largely to effects art director Joe Johnston. Johnston's earliest concepts were directed toward alienizing army tanks which the producers planned to procure from the Norwegian government.



When the option to use stop-motion animation came under consideration, Johnston devised a giant armored walking machine with multiple laser banks and animal-like characteristics. This early walker concept went through numerous modifications and refinements before being finalized.

ice planet scenes in Norway had to fight the worst winter weather in half a century. When the footage was shipped to Marin County and scrutinized, ILM technicians were groaning. Backgrounds intended for compositing with speeders and animation models were unstable and photographically uneven. Then screenwriter Leigh Brackett met her untimely death before completing a final draft on the script. Lucas contracted Larry Kasdan to replace her, and though the walker and tauntaun sequences were story-boarded, the entire screenplay needed heavy reorientation. "Brackett's draft had to be extensively rewritten by George Lucas," Dennis Muren pointed out. "The writers supplied the dialog and contributed to the story, but George was picking the moment, the direction, and the accent of each scene — what the purpose of each scene was, and who or what was being showcased." Several weeks of recovery brought the scenario back into equilibrium.

A massive period of design and engineering work lay ahead, beginning in the autumn of 1978 and extending into the summer of 1979. Muren's first concern was organizing the logistics of the effects scenes, while the others devoted their time to the drawing board. "Phil hadn't designed the tauntaun yet. He was coordinating his work with the British crew, sending his designs over and getting them back with suggestions. Jon Berg was designing the snow walkers with Joe Johnston. They were on the payroll and were keeping busy by constantly improving their designs. They continuously added things until they came up with what you see on the screen. While Jon was working on the walker armature, Phil was doing tests of tauntaun motion with a practice armature. The thrust of that period was just getting back into the swing of stop-motion. When the time could come to do a shot, Jon and Phil would feel comfortable; most of the obstacles would have been removed."

The look of the snow walker was the result of some inspired thinking on the part of its designer, Joe Johnston. "George Lucas and Gary Kurtz knew at the outset that there was going to be a snow battle, and they knew we were going to have armored speeders. But they hadn't really decided on what kind of vehicles the *Empire* would have or how they were going to do it. At first they considered using existing military tanks from the Norwegian army, redressing them to make them look alien. I did a bunch of sketches using the tanks as a basis. Then I ran across a xerox that a friend of mine had. It was a promotional brochure put out by U.S. Steel in the early Sixties and contained a whole slew of full-color paintings indicating 'what steel will be used for in the future.' The paintings were done by Syd Meade [*Star Trek* conceptual artist]. Interestingly enough, one of the paintings showed a four-legged walking truck! That's where the initial walker idea came from. It was a very unique design."

Meade's rendering reflected the rich imagery of the science fiction pulps and could have easily been a surreal version of a *Popular Mechanics* cover. Johnston took that design and started militarizing it, giving it guns and a separate head. He also used copies of some design sketches by Ralph McQuarrie as an added influence. During the selection process, Lucas, Kurtz, McQuarrie and Johnston gathered in a room. Lucas would extract a few sketches from the batch and comment on the design features he desired. Eventually the final design of the snow walker was realized. "It was more or less left up to me," said Johnston. "It amounted to a few sketches. Ralph, at that time, was going to England to do some paintings and full-size sets, so he wasn't too involved in the end of the design phase. The walker you see on the screen is basically my design, with some borrowed elements from the original painting."

When the mundane idea of using full-scale tanks was discarded, stop-motion became the immediate consideration at ILM. There would be no other way to do it successfully. “I believe that when George said there would be a full stop-motion department for *Empire*, the walkers had already been decided on for stop-motion,” Muren remarked. “We’re not sure exactly *what* George had in mind earlier on; it’s mostly supposition on our part. I remember, though, that the chess game in *Star Wars* seemed to be an ideal opportunity for him to try stop-motion, because the figures were supposed to be holograms and anything could happen — they could look funny; their movements could have that odd look. The same thought process applied to the walkers.”

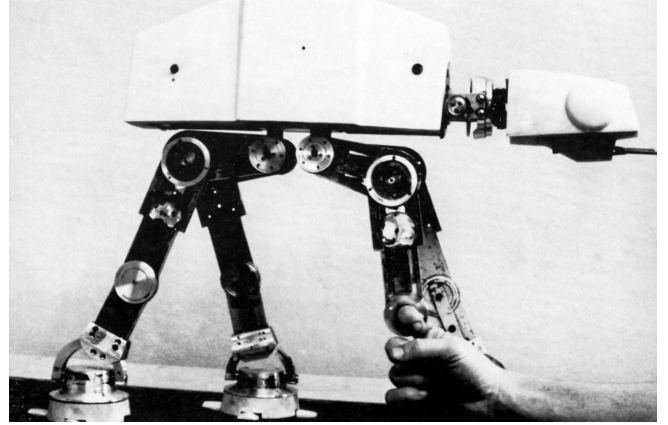
“It ended up being cheaper to do than using real tanks, which would have required models anyway for the special effects shots,” added Johnston. “As it turned out, we didn’t have to build any full-scale walker sets, except for a small section of the underbelly and the foot. It was something that hadn’t been done before in animation. It was a perfect type of puppet because the jerkiness that is inherent in stop-motion really lent itself to that kind of machine. I thought it had a lot of things going for it. It was a great toy.”

How the entire walker sequence evolved was somewhat bizarre. Johnston recalled the unorthodox development. “George would come in and say: ‘Hey, we’re going to have this giant battle. Start doing some storyboards.’ But there was no script! And George would say, ‘Don’t worry about that; just do storyboards!’ The process then was to lay out random shots and pick out some that would conceivably work. George would work on the script at home while I would be working on the boards. During our meetings, he would pick out shots that he felt looked promising and write them in. It was a very unusual evolution.” When the script was finalized, Johnston went back and redid the whole sequence. In fact, it was redone several times by both Johnston and an assistant whom he hired in September 1978. “The walker sequence always changed. On *Star Wars*, we generated about a thousand storyboards. Maybe four-hundred and fifty were used. The first version of any sequence is bound to change many times over; shots get transposed and eliminated. You just have to keep it rough.”

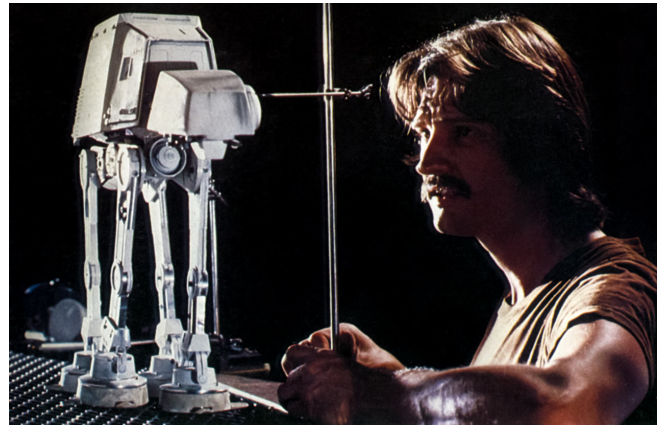
In order to devise the proper gait of the walkers and the tauntaun, the stop-motion crew photographed specific animals to help understand how their movements related to film. Phil Tippett and Jon Berg used this as a guide and set up a situation similar to Eadweard Muybridge’s *Animals In Motion* (a bible for animators) in order to break down running cycles and examine animal idiosyncracies. “We studied a lot of reference footage about a year prior to the shooting of the actual elements that went into the film,” said Tippett. “Ken and I did extensive tests to see if it would work. We spent several months doing that.”

For the huge, lumbering walkers, an elephant was chosen. Ralston and company went to Marineland’s Africa, U.S.A., south of San Francisco, and singled out a particular pachyderm. “I believe it was the same elephant that was used as the bantha in *Star Wars*. The trainer made it do all sorts of tricks and we shot it in a lot of different ways.” Much of the elephantine influence shines through in the walker animation. Joe Johnston’s idea, though, was to design something slightly zoomorphic without having it lose its mechanical quality. There is a certain logic to its almost camel-like profile, since the flat ice plains of Hoth suggest a vista similar to that of a desert-like terrain. Surprisingly, Johnston’s thinking gravitated toward a most unlikely animal. “It kind of moves like a cat to me. I have a cat; she kind of walks that way at times — stiff-legged, head down. There is

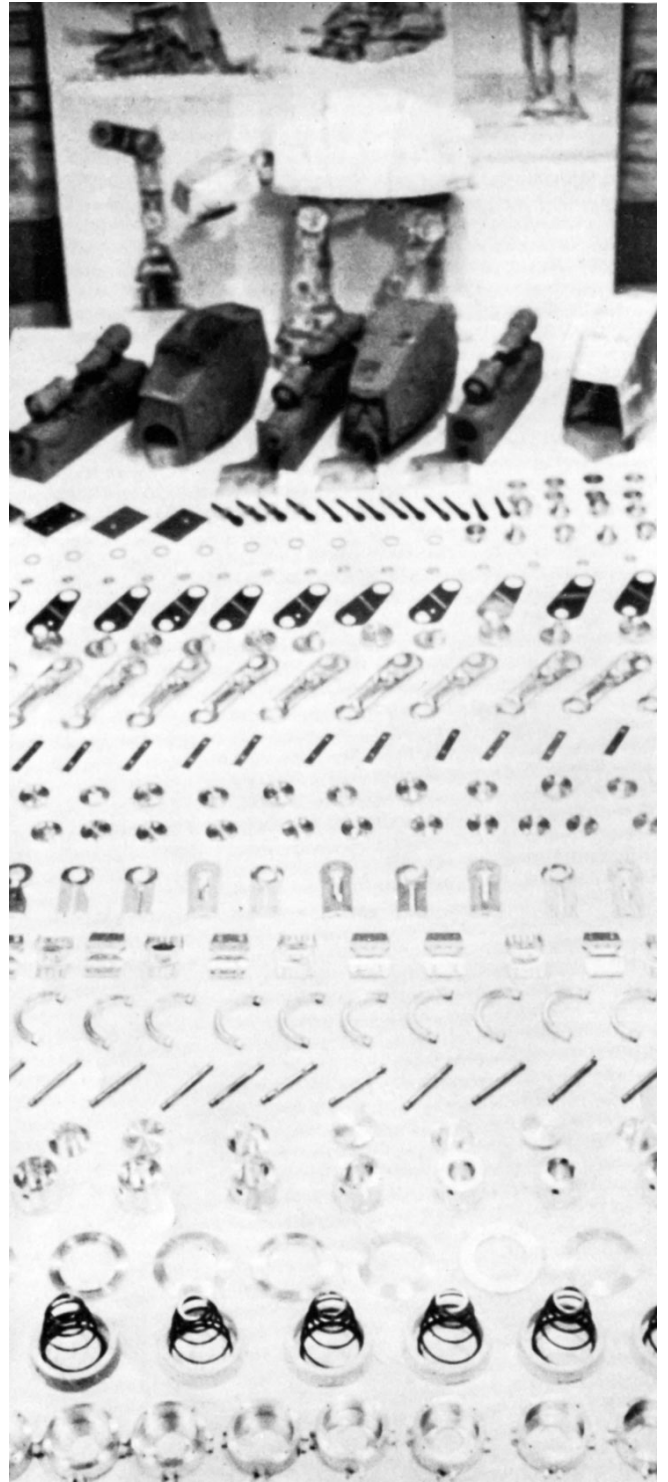
nothing particularly feline about the walker's appearance, but of all the animals, it reminds me more of a cat than anything else."



Animator Jon Berg spent three months constructing a functioning prototype from Johnston's walker sketches.



With his undetailed prototype, Berg was able to make many tests prior to the start of actual animation for the sequence.



Using Berg's prototype as a model, machinist and armaturemaker Tom St. Amand custom-fabricated enough armature pieces to build the three eighteen-inch walker models needed for the film.

A horse seemed to relate best to the tauntaun, since it had to gallop for several shots and rear up for one. Ralston and crew drove to nearby Stinson Beach and photographed it. "We knew this girl who had a horse. We placed markers in appropriate spots and had her run the horse using different paces. We filmed it from the side and every angle the horse had jumped. Phil used that to get the feel of how the tauntaun would move. During animation, he added his own characterization to it."

Jon Berg anatomized Joe Johnston's walker design and spent three full months laboring on an original prototype. "If there was one person responsible for getting the walkers on the screen," Johnston affirmed, "it was Jon Berg. He developed the entire armature working from just a couple of my rough sketches. And he managed to integrate a lot of experimental ideas which worked really well. Jon would always ask me if he was doing something that I would object to, or if he would be stepping on my toes. Of course, he wasn't. He has a great sense of design, I think. He sometimes worked fourteen hours a day on that walker prototype. His effort on the thing was really incredible. The only time he changed something from my sketches was when there was a mechanical problem — minor changes just to make it animatable."

"There were a lot of design elements in the walkers that, employing the techniques used before, there would have been no way to have it operate as a stop-motion puppet," Phil Tippett added. "Jon broke it all down and figured it out. It was a minor miracle of engineering."

The walker leg was particularly challenging. After careful study and experimentation, Berg developed a unique mechanism employing a system of pistons and cams. "Jon designed the cams to work in unison with those tiny pistons," Tom St. Amand explained. "The cam mechanism fit inside the leg, which was hollowed out. It had a little cover plate over it, so you don't actually see the mechanism; but it's there. It was a very creative idea. Everything was machined to be functional. He even engineered the feet to behave like shock absorbers, to take the



The cast urethane underbelly of the walkers being fitted together in the ILM model shop.



Meticulous painting by Joe Johnston served to enhance the scale of the walking machines and give them an aged appearance.

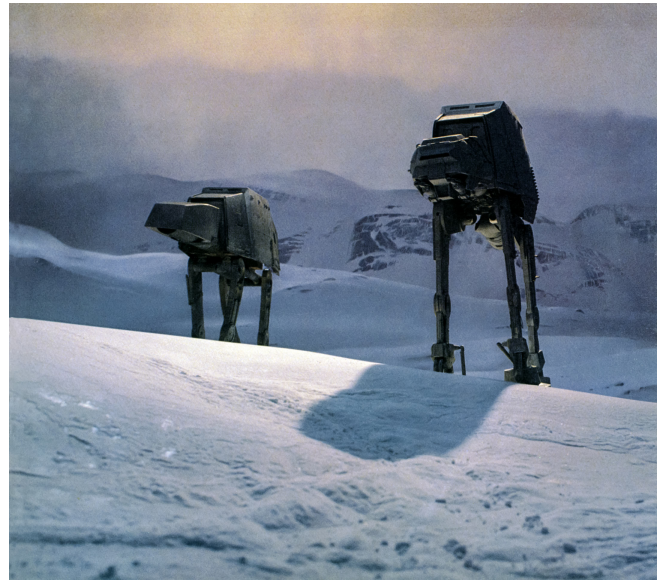
weight.” Once the basic structure was completed, Berg embellished his *objet d’art* with painstakingly applied detail, including tiny guns that could be made to recoil on interfacing slides during animation.

Three primary walker armatures were eventually built by Tom St. Amand using Berg’s prototype as a model. The contraptions stood eighteen-by-twenty inches when completed by the model shop. St. Amand had to custom-build each part from scratch; there weren’t any available for purchase.

“When I started, the parts design was all laid out. All I had to do, basically, was take Jon’s parts and duplicate them, which I did with virtually no changes. They were very strange joints. Most of them were hinges on swivels. The hardest thing was machining parts you knew would be seen. I had to machine odd shapes for joints, which was quite unusual. Hinges and swivels are pretty standard things, though; not everything on the walkers was done using that technique.”

A virtual exoskeleton, the snow walker model *was* the armature. The upper portions were cast separately in urethane, and assistant art director Nilo Rodis painted all the exteriors. Because of the model’s weight, the joints had to be unusually tight and were loosened during animation, which was something of a nightmare. The machines were designed to move in minute increments, which averaged a thirty-secondth to a sixteenth of an inch per frame. “The engineering was done very carefully,” Tippet remarked. “The problems were so much greater than those of a conventional armature. Problems are really compounded by the nature of the structure — you can’t fake anything. Tom ‘cleaned up’ most of Jon’s design work and came up with a pretty neat stop-motion walker.”

Rather than using a conventional tie-down system in which threaded rods and wing nuts affix the puppet to a working surface, Berg resorted to ball-lock pins, more commonly known as “pop pins,” to better accommodate the weight of the model. The device consisted of an eight-inch rod with a plunger on one end attached to an internal spring mechanism. When the plunger was depressed, two metal balls popped out of the other end which had been contracted within the rod itself. Interfacing with the pin was the shaft of the walker’s leg. The top of the shaft had a larger space. Once the pop pin was inserted and the plunger depressed, the balls were released and occupied this space. Secured by a bolt, it became a perfect anchor. Pop pins provided rigid support for the cumbersome walkers and eliminated the time consumed in screwing standard tie-downs into all four legs of each model.



Two walkers — one completed and one still under construction — positioned for a preliminary test of one of the snow settings used in the sequence. Only a handful of the walker shots employed the bluescreen matting system. Most were staged in miniature sets patterned after the Norwegian locations used for the live-action shooting. Working from transparencies or photographs, artist Mike Pangrazio executed a number of highly-detailed large-scale background paintings. Depending upon the action to be photographed, foregrounds were either painted by Pangrazio, or constructed in miniature under the supervision of assistant art director Nilo Rodis.

The newly-developed Empireflex, one of the pride and joys of ILM, became the primary camera used for the stop-motion sequences. Superbly engineered by Richard Edlund, it houses a mirror-reflex VistaVision system, employs a Mitchell movement, is small and portable, and has a motion control capability enabling it to be programmed for pan and tilt. In the stop-motion mode, the Empireflex could hold on a frame and automatically advance to a new position during exposure, thereby introducing blurs on the pans while the shutter was still open. Or it could run through the entire movement continuously. Unlike the Dykstraflex, though, it had mobility limitations. "All the walker shots that had a lot of moves on them were done with the Dykstraflex," Dennis Muren explained. "The only reason is that that camera has a boom arm, enabling us to get speeder point-of-view shots. All the other walker and tauntaun shots used the Empireflex. If there are no camera moves, or if there's just a slight pan or tilt, it was done with the E-flex. As far as tying in stop-motion with motion control hardware was concerned, it was fairly obvious how the two would work together. In *Star Wars*, we had stopped the motion control unit in the middle of a shot and replaced a TIE fighter wing with a broken one. So we knew we could stop-start continuously with no problem."

Unique to the operation was the use of the Lyon-Lamb video animation system, a tape unit that records one frame of video at a time and could be played back on consecutive freeze frames or twenty-four video frames per second, the normal sound speed for film. Tippett and Berg were able to get an instant replay of the animation as it was being shot, allowing them to pinpoint mistakes and get an idea of the action flow. Muren had used a similar system twelve years earlier at Cascade Pictures, but it was rejected for *Empire* because its replay capability was limited to thirty frames per second, the normal playback speed for video. "For all the stop-motion sequences," said Tippett, "we used the video as a check. We'd shoot a scene, and before we had gotten too far into it, we'd check our video to see how it was turning out. Then we'd shoot the entire shot and check the video again. That way we wouldn't have to wait to see the dailies the next day."

Physically approaching a shot was very much in league with a surgical operation. Once the lights had been set, the model prepped, and all preliminaries ironed out by the camera assistants, Tippett would step in and perform his job. "Generally, everything had to work the first time. The amount of testing we were able to do in the months preceding, on the fabrication and experimentation of movements, really paid off at that point. That was one of the things I was happiest about, having had available to us the time to experiment up front."

Muren and crew hardly had time to do any testing on the setups themselves. "We started shooting in February 1979 when the cameras were set up, and went until June. At that time, I just stopped shooting. Ken Ralston and Don Dow and Jim Veilleux continued on camera, and I supervised for a couple of months. Then I began to organize the walker sequence. So there wasn't much time to test out shots. Phil had his end worked out; the armatures were functioning properly, and the puppets were cast. The only experiment we did was a bluescreen walker test. Everything else went right into the show; it was one shot after another. It wasn't as though we were playing around for six months trying to figure out the best way to do things, because we were shooting the asteroid sequence and the Vader ship and other things constantly. The only cameras we had running during that period were the Dykstraflex and the Technirama, for months and months."

Muren started figuring out how to do the walker and tauntaun shots in July 1979. It was an organizational process, breaking down the storyboards, redesigning and combining them so the

same set would work for a number of shots. “That was a process that went on throughout the entire show in all departments,” Tippetts affirmed. “We’d look at the storyboards to see what was required and add whatever dynamic qualities we felt should be there. Dennis completely rearranged the walker sequence to get the result he wanted.”



The opening walker shot employed five walkers positioned against a Ralph McQuarrie background painting.



Phil Tippetts and Doug Beswick animate their respective walkers for the opening shot. Only the three foreground walkers are actually articulated models. The two in the rear are simply photo cutouts mounted on sliding tracks.

Before the first walker tests were done, however, Dennis Muren had some monumental decisions to make. Looming over everyone's head was the unresolved question of how to marry the stop-motion walkers with the storyboarded backgrounds. Blue-screen had been a fairly reliable matting system for *Star Wars*, and Edlund's optical printer design being developed for *Empire* looked promising. The technique would work well for flying objects in outer space, but the nature of the walker sequence made for complications.

"When we got the film back from Norway, we had all these plates that weren't in any kind of order. We had a plate sequence of about twenty shots, and we had to generate about *eighty* – forty speeder shots and forty walker shots. There was no organization at all. So there were any number of ways to go with them. We could resort to full miniature sets, painted backings, or a mixture of both. Rear projection was something I wasn't really satisfied with. We needed a system that could work in some form of production line manner, without worrying about whether a process projector bulb would blow out during a shot or if a projected background plate would have a color shift. We could pick out plates and cut them together to make a sequence for blue-screen walkers and speeders. But we were very worried about what the mattes would look like — what the edge characteristic of the walkers would be. The walkers needed to move very slowly; we had to *hold* on shots in order to really see them, unlike the tauntaun shots which were really moving around."

To resolve the matter, Ken Ralston shot a bluescreen test with a walker on each side of the frame, similar to a scene that might appear in the film. "The reason for this," Muren explained, "was to see how the matte would fit for both walkers. There wasn't any movement in the test. The walkers were just stuck against a static background to see how that one technique would work. What happened was we couldn't get rid of the matte line on both sides of the frame at once. Whenever we got rid of the matte line in one place it would pop up in another. There were also a number of other problems — film shrinkage and all the intermediate steps. The holdout matte therefore might not fit the walker. This happens on practically every matte shot, but it's usually repositioned to a point where it *does* fit in the area where your eye looks. That's consciously done by the printer operators for each shot. On all the cockpit shots done in England, for instance, the mattes generated at ILM were always fitted to conform to the actor's face, which would be the center of attention. If you'd look to the back or to the side, however, you might see a matte line. Anyhow, there were a number of walker shots where a walker had to fit on each side of the frame. But according to our test, the matte edge looked funny. So it was composited and discarded. We did end up using bluescreen for



Jon Berg animates his walker for the shot. Articulated surface gauges aid the animators in keeping track of the minute incremental adjustments made on the model between each successive frame. For some of the more complex shots, an hour's worth of animation netted only a second of finished film.

three shots at the end of the sequence, including the one with the people running in the foreground, where the walkers were small. But for the major shots, the technique could not be used successfully.”

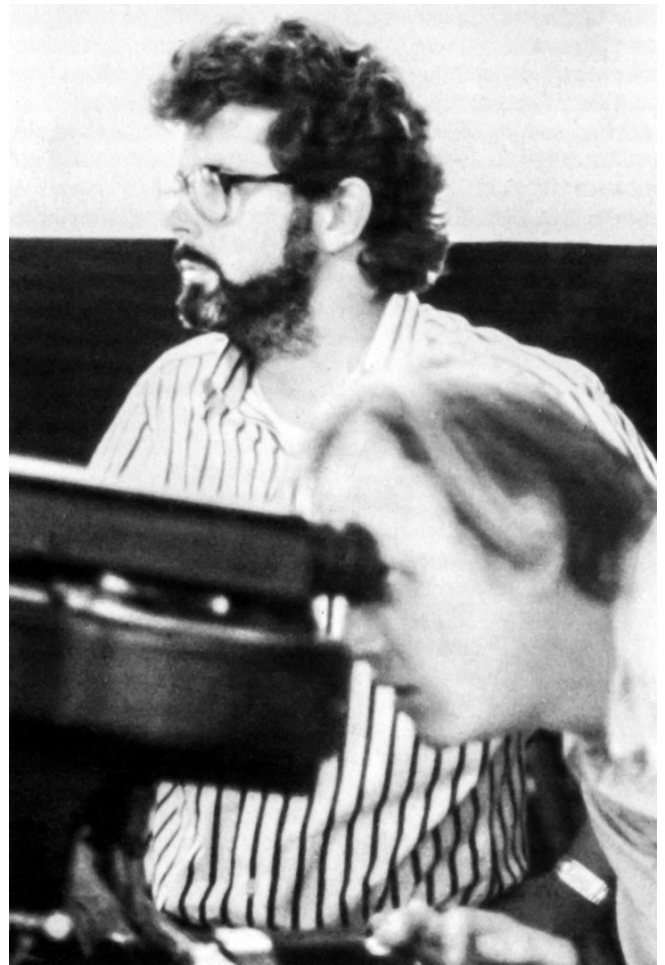
The final solution came with a reverent nod to Willis O’Brien and the tradition he had established forty-five years earlier. Painted backings were used in conjunction with foreground miniature sets and a multiplane glass arrangement for diffusion and snow effects. “We were very conscious of the fact that some of our setups were similar to those used in *King Kong* and *Mighty Joe Young*. We’d walk in in the morning and look at one of those setups and say to ourselves, This must’ve been the way it was.’ ”

Mike Pangrazio painted the backings for the snow walker sets, the largest being thirty-five feet wide. Ralph McQuarrie did the backing for the first walker shot where five machines are approaching; the rest was Pangrazio’s artistry, amounting to more than a dozen mural-like paintings for the walker and tauntaun shots. Originally hired to do matte paintings, Pangrazio was brought onto the stop-motion team by Dennis Muren. “We got along very well. Mike saw a lot of what I was trying to do and was very curious about Phil’s work. He and I would talk a lot about light and color; what makes a shot work and what doesn’t. We were really seeing the same thing. He recognized the background requirements and I recognized his talent. It was just natural that we would work together easily. The *original* idea I had during our first meetings was to use painted backgrounds. I thought we’d get better results with the reality of it. In doing the bluescreen walker test, I was curious as to what would happen, expecting what *did* happen. That just proved it out. But there was still real aversion to our final approach of using painted backgrounds. People associate them with *Green Acres* and *The Beverly Hillbillies* – it always looked like that. That’s just because they didn’t have the right artist to do it. They didn’t give enough attention to the blending. One of the big issues was that Mike Pangrazio insisted on working from transparencies or photographs. He didn’t want to use his imagination. He said: ‘Every time I try to create something, it doesn’t look real. It looks interesting, though; it takes on a style.’ But as a result, it usually looked artificial.”

The main walker set was situated in a room approximately twenty-five by fifty feet. One side contained the large setups and backings; the other side was cordoned off for bluescreen work. A crew of five usually spent four or five days on the major shots using O’Brienesque tableaux; bluescreen shots generally required one or two days work. Jody Westheimer, Mike McAlister and Chris Anderson were the camera assistants intimately involved with the walker and tauntaun scenes. “Jon worked hard with Chris on most of the walker stuff,” said Tippett. “When we got to do the taun shots, Mike and the others would assist me during the animation, making sure that the camera was functioning properly. It was necessary to have people monitoring the motion control equipment and the video check. They double-checked and triplechecked every single thing that they could. Also, there were a number of very complicated color blends that had to be done during the shots. Mike and Jody monitored that, making sure that there weren’t any color shifts. Once it was ready to go, Dennis would back away while Mike and Jody and Chris were involved in the actual photography. So all their focus and attention would be on the shot without having to worry about the setup. That was the main thing for me, not having to worry about the f-stops with all those layers of glass.”



Mike Pangrazio at work on one of his background paintings used in the walker sequence.

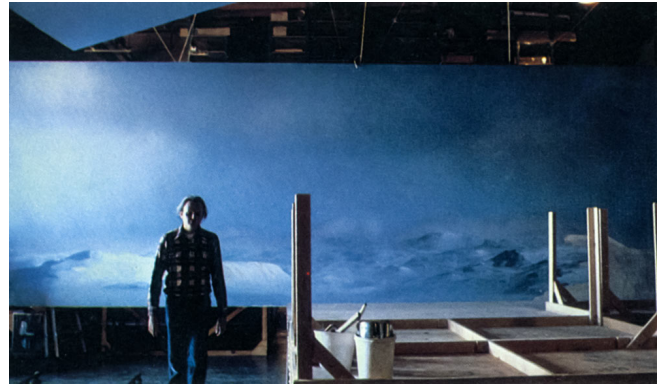


Effects director of photography Dennis Muren lines up a shot, as executive producer George Lucas observes. Lucas was very much involved with the activities at ILM during the Empire effects work.

Nilo Rodis was primarily responsible for the construction of the miniature snow sets. Crucial to his thinking was the material to be used for simulated snow. “One of the things Jon Berg felt should be was to have the walkers crunch down on the snow,” said Tippett, who co-animated them. “That meant dealing with an unstable surface. That complicated things a lot, as you can imagine. You can’t cover up a mistake, and you can’t bump the surface with your arm.” Rodis interfaced with the animators and decided to use baking soda for snow. The original idea was to use micro-balloons — microscopic plastic beads used in the casting process to create a light airway and to add strength to resin compounds. The idea was discarded, however, because the surface tended to “float.” Baking soda looked more authentic. Surgical masks were worn to avoid unnecessary inhalation.

The opening shot of the walkers illustrates one of the more complex approaches taken to provide a specific point of view. As a rebel officer looks through his electrobinoculars, he spots the approaching machines. The binoculars scan the walkers from head to toe while a built-in digital readout designates their location. To achieve this scene, the stop-motion walkers were filmed in VistaVision with a telephoto lens, the camera locked off. Twelve seconds of animation were shot. The film was then front-projected onto a six-foot screen and rephotographed on tape using a ¾-inch Sony video camera. Blurs were introduced here, along with a zoom-in on a walker’s foot and a tilt-up to the moving head to give it a *video verite* look. The tape was transferred back to film during which a binocular-shaped matte was added. Digital readouts were superimposed. “The shot had everything that would take place in a hand-held binocular situation,” said Muren. “Because of all the generations and contrast, the final result looked almost black-and-white.”

Not since the original *King Kong* had the movies seen aircraft point-of-view shots moving frenetically toward stop-motion models. For the *Empire State Building* “bullet spray,” O’Brien’s crew



Muren stands before a completed Pangrazio painting. Depending on the demands of the shot, background paintings ranged up to thirty-five feet in length.



Nilo Rodis and model maker Scott Marshall work on one of the miniature sets.



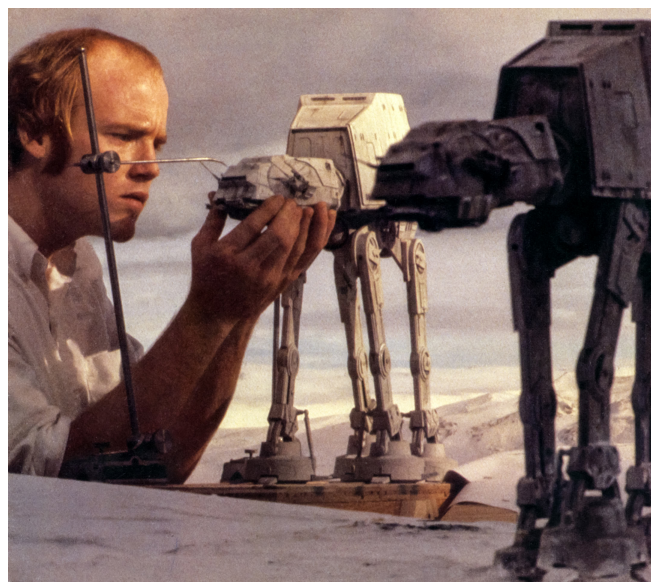
Doug Beswick and Jon Berg animate during one of the three-walker shots. Surgical masks were worn to avoid excessive inhalation of the baking soda which was used to simulate snow.

had to construct a twenty-four foot ramp on which the camera was animated while Kong gesticulated furiously at the lens. Similar shots for the walker sequence were brought off effortlessly using the Dykstraflex, a sharp illustration of the gulf between hammer-and-nails thinking and modern technology. What *hasn't* been changed, though, are the hardships of animation under physically straining circumstances. In order to facilitate stop-frame manipulation during the POV shots, trap doors had to be built into the snow set. Phil Tippett recalled the ordeal.

“The doors were built into our largest set. We’d open them, animate the puppet, go back down, and close the door. That was just one of the problems. There were other considerations about trying to animate the thing on the end of a Nike boom arm, but there was really no way to grab the puppets other than the trap door arrangement. That was probably the most *grueling* animation on the whole show, having to be under the tables.” Covering the trap doors was a layer of modeling paste upon which baking soda was glued and meticulously blended with the rest of the set. The system was Jon Berg’s idea, who developed it with Nilo Rodis.

For a POV shot of a speeder sailing through one of the walker’s legs, the walker was simply removed from the set once the Dykstraflex lens cleared the opening. Though relatively easy to film, the shot had more significance than meets the eye, as explained by Dennis Muren. “The entire set that had to be built for all those speeder POVs was based on that *one shot*. It was as big as Mike Pangrazio felt he could paint comfortably; that determined the size of the backing. The size of the set was based on what the start of that shot would look like. So after speculating on how big it should be, and having built it to that specification, and having the painting finished and lit, then it was a matter of photographing it and seeing how well the pre-visualization of it looked. It turned out to be fairly accurate. But in making the move, we had to make sure we weren’t shooting off the set. There was no extra landscape.”

When walker animation began, it became evident that a third animator would be needed, particularly for the shot featuring five walkers. Doug Beswick, who had been working on the tauntaun armature, was called in to assist. Some of the technically finer moments in the unreleased *Planet of the Dinosaurs* point to the quality of Beswick’s work. “I animated on four or five shots that contained three walkers. I usually had the one furthest back — it was fixed to a board. The front ones Jon and Phil animated were done in snow, which was extremely difficult. For the five-walker shot, the two background ones were just mock-ups. Actually, they were photo cutouts that move infinitesimally on a track. The legs of the cutouts had some small articulation to them. The photos were taken from the angle the background walkers were meant to approach from. An armature was built into the



Phil Tippett meticulously adjusts his walker for the next frame of exposure. The foreground model, animated by Jon Berg, was actually made to walk on the unstable snow surface — a procedure which involved extremely precise and exacting manipulation of the puppet and its immediate environment. Since the feet of the background walker were not visible in the scene, it was animated on a wooden platform.

backs of them. The cutouts are dead-on to the camera, but the perspective of the photograph fools your eye. I slid them on the track obliquely, just to suggest some movement.” Even more startling is the fact that the walker cutouts were actually 8×10 Polaroids, heavily retouched. “We could retouch a photo in twenty minutes, or take four days to build a model,” said Muren. “The choice was clear.”

Beswick spent five days doing stop-motion work. “It took a full day for each shot. The shot usually ran four to six hours. The time on the screen lasted four to six seconds. That’s a second an hour. A cameraman would be on hand to run the Empireflex, so we didn’t have to be concerned with that. The increments for the walker movements were so small, they could hardly be gauged!”

Joe Johnston made a photographic record of the ordeal for all time. Setting up his 8mm movie camera near the walker set, he clicked off a frame every five seconds and pixilated Berg and Tippett animating. “Most of what you see is Jon and Phil jumping up and down. If you look carefully at the film, you could see the walkers moving.”

One of the oddball images in several walker cuts is that of a two-legged scout machine which darts by and exits screen left. The crew dubbed it the “chickenwalker” because of its strut. Jon Berg and Tom St. Amand built the armature for it. “I had already built a plastic model of it,” said Joe Johnston. “George saw it one day and said: ‘Hey, that’s really neat. Why don’t you put it in the show?’ Jon said, ‘We’re still thinking about what would be the best way to do it.’ We were going to build a completely new chickenwalker. But we ran out of time. Since Jon had already built a new armature, I took the prototype chickenwalker parts and glued them to the armature. Then Tom worked on the joints, making it operate smoothly. So it’s basically the display model that ended up in the film.”

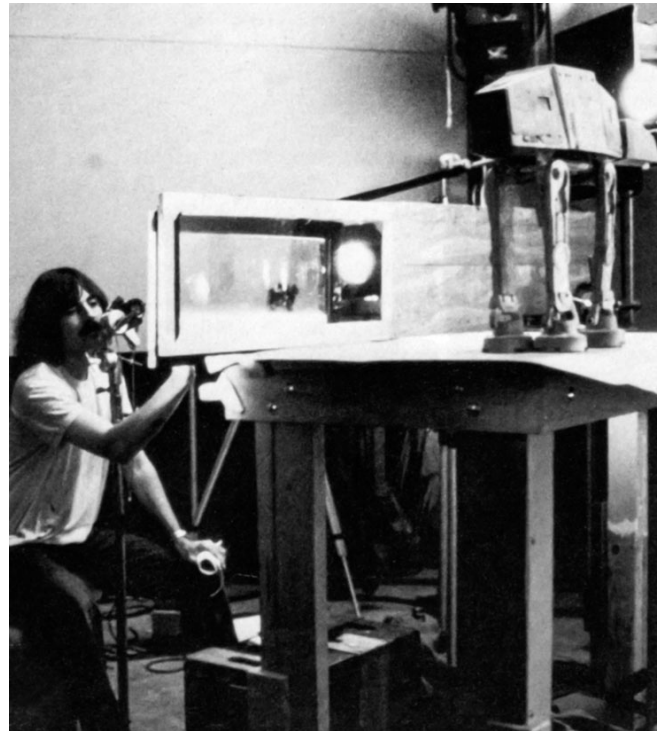
St. Amand animated the chickenwalker against a bluescreen. Ken Ralston shot the foreground element: “The two-legged walker was the result of Joe and Jon getting together and putting something into the film that wasn’t even planned. It was just another element of the strange’ — another creation that’s just out there with the walkers, and *who knows* what it’s doing!” A third chickenwalker scene was filmed and scrapped. The shot depicted a three-quarter view of a speeder strafing the scout walker. It didn’t cut in.

Ralston animated the scene of Luke hauling himself under the lead walker with a rope. Originally it had been done on cels by John Van Vliet of the roto department before the decision to do it dimensional evolved. A tiny Luke puppet was fabricated. Ralston animated it bluescreen using Van Vliet’s hand rendering as a guide. The cel-animated rope element was retained for the final shot and combined with the matted-in Luke puppet. Ralston did a similar shot toward the end of the film when Luke is seen hanging from the bottom of the Bespin cloud city in extreme long shot.

Another “element of the strange” was the probot (Imperial probe robot) seen briefly at the start of the film. Essentially an orbbed circular head connected to a cylindrical body equipped with cameras, sensors, and metal appendages, some of which terminate in crablike pincers, the probot drifts across the ice plains searching for lifeforms. On reflection, it bears an odd resemblance to the creature in Roger Corman’s first genre film, *The Monster From the Ocean Floor*. Dennis Muren described it as “a multi-armed ball that walks around.” Ralph McQuarrie did the basic design. Joe Johnston did a few sketches after his, which mostly detailed the probot guns. The puppet probot was animated by Tom St. Amand for one shot in the film. “It was actually the first miniature to be completed by the model shop,” he revealed. “The probot was shot bluescreen. It was difficult to keep

track of all the legs of the spider-like contraption. Some of them had to move forward, some backward. I believe the armature for that was built by Lome Peterson, Charlie Bailey and Paul Huston. They also built the final puppet with Steve Gawley, Tom Ruddock and Ease Ouyeung.”

Dennis Muren shot a “live” scene using the probot puppet — the fifth shot of the film where it rises out of a smoldering crater like the Martian machine in George Pal’s *War of the Worlds*. The model was fastened to a teeterboard in a scaled-down set and elevated slowly by leverage. Filming it required a multitude of personnel, as recounted by Joe Johnston. “There were about ten people doing that shot. There were so many things going on! One guy was stationed in front of a fan and threw handfuls of baking soda at the right moment. Phil was down there, Dennis was behind camera, Mike Pangrazio was doing the smoke, and Tom was in there, too. So you had an animator, a cameraman, a machinist, a model builder or two, a matte painter, one of the girls from the front office — in fact, anyone who wasn’t doing something in the building was called in for that shot. A cast of thousands!” At other times, the probot was an eight-foot prop the English crew had built, shot high-speed to slow up its movements and further the illusion of great mass.



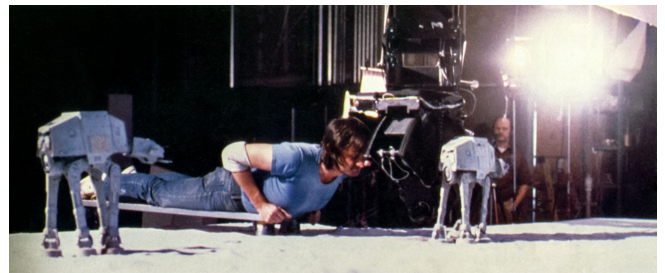
In addition to his background paintings, Mike Pangrazio prepared numerous foreground paintings on glass to introduce landscape features or obscure the walkers’ feet, which facilitated animation.

Also done high-speed was a larger-scale miniature walker used for two scenes — an explosion shot triggered by Luke tossing a detonator into the lumbering machine, and one where it collapses in the snow. The walker stood four feet high and cut adequately with the eighteen-inch models. The photography was done by Richard Edlund, high-speed being one of his fortes. Doing this, though, was a major headache. Doug Beswick, who worked on it, recalled some of the problems. “The legs of the walker were trouble spots. They were underbuilt; they weren’t strong enough. We had no idea how heavy the model would be. In fact, we had a contest to see who could guess the walker weight. It must’ve weighed ninety pounds. The model shop was building the body while Tom and I were building the legs. The feet were huge pieces cast from epoxy. But by the time they put the body on it, the mechanism would not sustain the weight. Ratchets were made so we could lift the walker up and position it. The ratchets would hold its position. It had electrical wiring that went back to control panels. This could trip and release all the legs or one joint. Once the ratchets were released, the thing would collapse. It worked just fine when we put the legs on. But once we put the *body* on, it was just too heavy — the ratchets stripped right out. Originally there were three scenes where the walker falls; the film used two of them.”

The roto department enhanced the entire sequence measurably. No other effects film ever employed so startling a combination of stop-motion models and cel-generated images. Only *Kronos* could boast a slight comparison — the title character, interestingly enough, being a walking machine. Peter Kuran animated the cables that tripped the walkers, and provided light reflections on the walker bodies. Garry Waller generated dozens of moving flak bursts, while John Van Vliet and Kim Knowlton each did simulated smoke for disabled speeders. Van Vliet animated his under the camera using a rubbed pencil technique, expanding the same piece of



Dennis Muren took great pains to insure the walker shots had an outdoor, sunlit look. Gels were sometimes used to throw a bluish cast on background scrims which served to duplicate the natural diffusion effect found in most outdoor photography.



Being careful not to disturb the snow, Jon Berg checks a Dykstraflex line-up during one of the motion control shots in the sequence.



Phil Tippett and Jon Berg employed the Lyon-Lamb video animation system (right) to provide instant replay

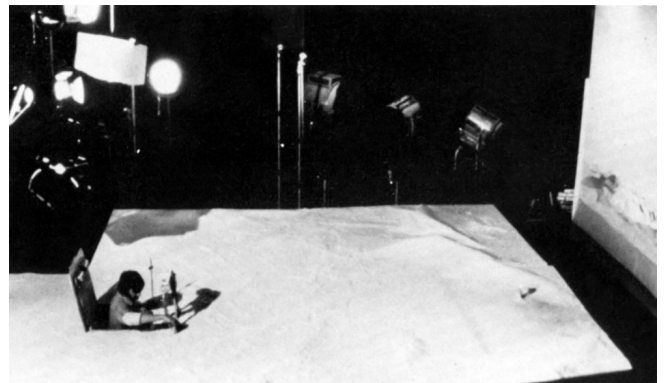
artwork for each successive frame. Knowlton did hers drawing by drawing. Both were used in the film. Essentially background elements, they sweetened the walker shots and added life to the inherently lethargic machines.

capability as they animated for the principal VistaVision cameras.

For the POV shots taken from the interior of the speeder cockpits, a technique was used diametrically opposed to the large-scale walkers. The British crew had filmed the live-action cockpit scenes in front of a bluescreen. The image to be created and composited by the ILM crew into the window area was the approach of the distant walkers. A decision was made to heighten credibility by using a real helicopter shot as a landscape and matte several tiny walkers into it, producing a window background. The primary reason, though, was to take the load off stage photography by eliminating the need to construct a deep set for the distance factor. In some shots, the walkers would have to be seen way off on the horizon. The camera would therefore have to be an enormous distance away from the models at the farthest point, requiring a lot of stage space. Since the smallest walkers at the time were the twenty-inch walker puppets, creating slightly smaller versions for a forced-perspective set would have been utterly time-consuming. Moreover, a Dykstraflex move on such a setup might not look natural.



Joe Johnston demonstrates, for special effects supervisors Richard Edlund and Brian Johnson, how a motion control speeder will appear to fly through a stop-motion walker's legs during the snow battle.



Jon Berg had to use a trap door accessway to the middle of the set for point-of-view shots from the speeders as they soared in over the lumbering walkers.



For shots requiring a great deal of camera motion, the original Star Wars Dykstraflex camera was used because of its lighter weight and highly maneuverable boom arm.



Model maker Mike Fulmer fashioned tiny articulated walkers for use in a distant horizon shot.

Mike Fulmer and Charles Bailey of the model shop fabricated several tiny walkers, one and one-half to two inches high. Bailey made the smaller ones out of resin; they were nonarticulated. Fulmer's miniatures were made of metal, with incredible detail. His lead walker incorporated a hinge arrangement that enabled the head to move back and forth by manipulating the front legs. "They could be animated to a certain extent," said Fulmer. "Not with much finesse, though, because they were so small. Sam Comstock of the roto department set them up to 'walk' on the snow terrain as seen from the cockpit."

Comstock's first step was to examine and plot the movement of the plate — a Wesscam helicopter shot filmed in Norway. Using ILM's Oxberry animation stand, Comstock employed a "matched move" technique, a rotoscope process whereby the move of the background plate is plotted frame by frame using a registered set of reference marks traced from the first frame of the plate. A foreground object to be matted in — be it artwork or a model — can then be made to match the background move by repositioning the object frame by frame according to those plate calculations and filming them on a separate piece of film. "I'd pick a rock or a horizon line, or both — whatever reference points I could find on the plate — to plot the movement of the original photography. As I went from frame to frame, I'd realign the bed of the animation stand to fit back into the image. If the image bounced to the left, I'd crank the bed over to the left and realign my little mark into the previous position. In doing this, calculations for the matched move of another element would be determined."

For the five or six POV shots required in this instance, Comstock did a test. "I was given a helicopter plate at random and a little walker, and they said, 'Here, try this.' So I shot a test on the animation stand of the walker standing off on the horizon by matching it up to a hilltop. It worked out fine. There were four or five shots later on where I did get reasonably close to the models."

After plotting points on the actual plate used in the film, Comstock placed the matchbox walkers on the Oxberry table, each having been fastened to a single sheet of plexiglass by vertical rod-mounts of various lengths. "For a few shots, there would be a couple of feet *between* walkers. I could cheat using two different walker sizes and forcing the perspective. The farthest point from the Oxberry camera to the farthest walker was ten feet; the closest I got was about twenty-five to thirty inches." Since the camera was photographing the walkers pointing straight down, the rod-mounts were automatically obscured by the walkers' bodies. It was a front light/back light matting situation. The



Sam Comstock animated them on the Oxberry animation stand, along with other nonarticulated mini-models built by Charles Bailey.

walkers were placed on the Oxberry table as a light source for the matte. Two frames of each walker position were shot. For the front-lit frame, I placed some black cardboard behind the walkers to better define their shape and eliminate background reflections. On the alternate frame, the cardboard was removed and the back lights underneath the table were turned on to get a silhouette of the models. That film was skip-framed by optical and transferred to two different stocks — one for the front-lit walkers, and one for the matte. When a countermatte was generated from the matte roll, it allowed the walkers to be printed into the plate I had plotted. Their moves matched the background since I was repositioning them to accommodate the background move.



Bluescreen traveling mattes had to be used whenever the walkers appeared together on screen with human actors. Such shots as these were generally very complex, combining stop-motion elements, motion control speeder elements, cel animation, and a variety of physical effects shot on location.



To enhance the illusion of great mass, a four-foot version of the snow walker was shot high-speed by Richard Edlund for the scenes where the walkers topple over and fall. Jon Berg wraps cable around the large walker legs to intercut with the cel-animated tow rope fired in long shot by a rebel snowspeeder.

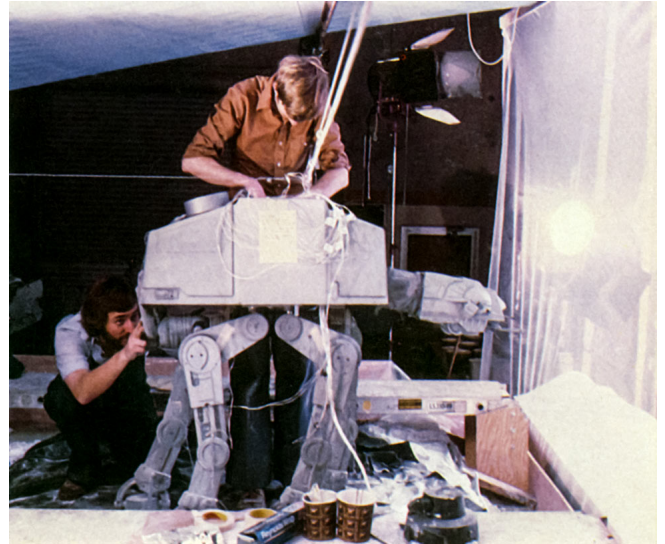
“Mike Fulmer’s little walker was really interesting. By manipulating it with a carefully controlled gauge, I got it to move at speeds comparable to those of the larger walkers. It was as close as I had gotten to doing stop-motion model work. Charlie’s walkers were solid casts and a little smaller, so for certain shots, I could shoot two at a time and make them appear to be standing on the horizon. About six shots were done like that.” Sam Cornstock’s walker shot became the background that replaced the bluescreen areas of the cockpit scenes. Uniquely, it was a composite within a composite.

For Dennis Muren, one major problem was the blending of large snow sets with painted backings. Stop-motion walkers are only as good as the skills of the animator, but the entire effect could be ruined without proper consideration for light phenomena. “We’re building a miniature snow set,” he illustrated.

“It’s going to have walkers and a tauntaun in it and a Mike Pangrazio background copied from a transparency. Mike’s color had better be right and the snow had better *appear* white — we were quite insistent on that. Because of the processing, the transparency came out with a greenish cast. In translating the transparency exactly, we could have had a funny-looking background painting. So Mike was constantly correcting that to get the painting to blend with the snow. The sets had to contain the same ‘white’ as the painting. Blending white on white is not as easy as it might sound. The biggest problem we had was making the sets look as though they were shot in sunlight. That was generally solved by not having ‘white’ snow. The snow was just *under* white, with a tinge of blue. The puppets on the set were overexposed by a half stop to a full stop. When this was done, the off-white snow translated to film as white, and everything else brightened up and looked outdoorsy. That worked well with the walkers — in overexposing the shot, everything popped out and looked brilliant.”

To capture the natural perspective of a location shot, the space between the models required different gradations of light. To achieve this, a lot of custom diffusion was done in addition to using appropriate camera filters. “Each walker usually required separate diffusion,” Muren revealed. “Sometimes just one area was diffused in front of the lens, resulting in something of a glaze. Other times we’d even put a colored light on the diffusion glass, just to add a little blue to it. We had scrims separating the walkers, similar to sheets of bridal veil, in order to create the illusion of distance. That airbrushed publicity shot of the three walkers advancing from the side [Cinefex 2 cover) had more stuff going on than any other shot in the whole show. That shot was given a lot of thought to give it depth and that sunlit look.”

Another consideration was the *softness* of each shot, a prominent feature of the Norway footage. “Part of this was due to the fact that things focused on off in the distance are not as sharp as things focused on near the lens. When we had to intercut all that material with our computer-designed



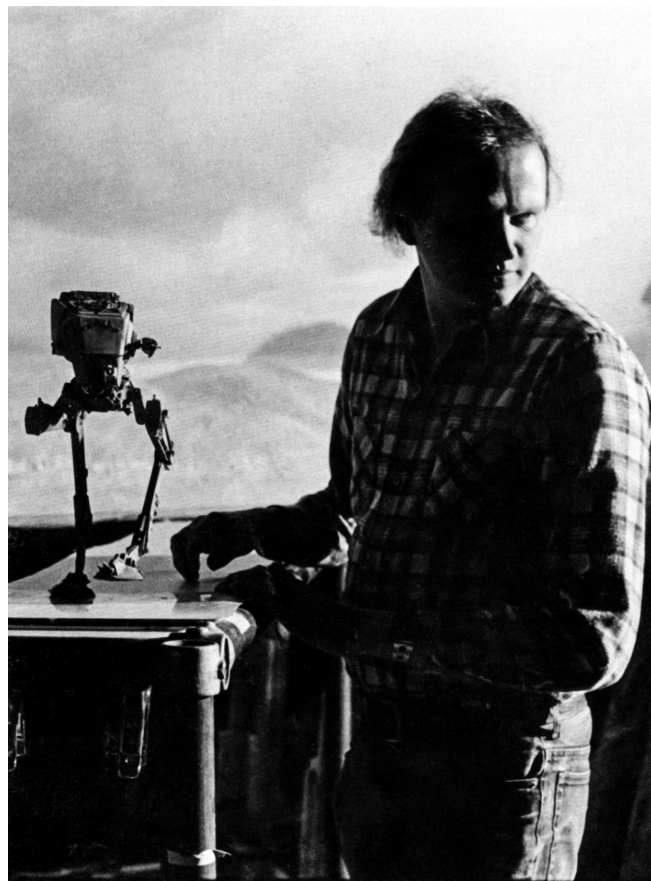
Pyrotechnics experts Joe Viskocil and Dave Pier rig the largescale walker with miniature explosives for another highspeed shot. The walker was carefully positioned and then held in place with ratchets and cables which were released at the start of the fall.

super Nikon lenses in the shooting stage, the difference was just enormous! So *everything* had to be softened a bit, especially in the walker material.”

Because of the bad weather in Norway, many plates were shot in heavy overcast while others were taken in bright sunlight. The inconsistency became another headache for Muren. “I was trying to find a way to deal with all this. Since my job was to decide how the scenes were going to be done — whether we were going to use background plates, miniatures, or painted backings — it was important that we had a continuity to the look of the snow scenes. As it stands, the walker sequence ends with Luke climbing up a rope and blowing up the walker. That’s not the way it used to end. That sequence came *toward* the end, originally. The shots of Luke running were done under a heavy overcast. So George rearranged that for the end. It worked better dramatically, and it also helped *us*, because the way I came up with it was to have a progressive snowstorm. The shots of the troops start out in morning sunlight, and throughout the sequence the overcast builds up just for continuity’s sake. That was violated, though, a few times. We were very rushed to shoot the high-speed walker footage, and some of the backgrounds we used in those instances did not conform to the continuity we were seeking. I don’t think anybody noticed it.”

Phil Tippett’s main concern was the tauntaun creature. Odd (and typical) as it may sound, an early consideration for the taun was to use a man in a suit, one of a number of different approaches experimented with in England in an attempt to see what would look best. “They gave it some thought,” said Tippett. One need not wrench his/her imagination to visualize how obvious and unmagical the first half hour of *Empire* would have been using tauntaun suits and full-scale tanks. Joe Johnston recalled the turn of events.

“It happened in July 1978 during one of Phil’s visits to Marin County. Originally the producers were going to use a man in a taun suit. When our department started designing it, we had that in mind. So we were locked into that for a while. Then Phil came along and said: “This isn’t going to work. How about if we do something like this?” He had already sculpted the animal. When he came up with that, we threw most of the tauntaun sketches away. As long as Phil was building and animating it, we felt that he might as well design it. Actually, the second line of thinking was: why don’t we do it mainly in stop-motion and let the man in the suit *copy* the puppet’s actions? It had first been suggested the other way around. But Phil’s idea of doing it all in stop-motion worked better. After that, we didn’t do any more tauntaun designs. We just let Phil take it from there.”



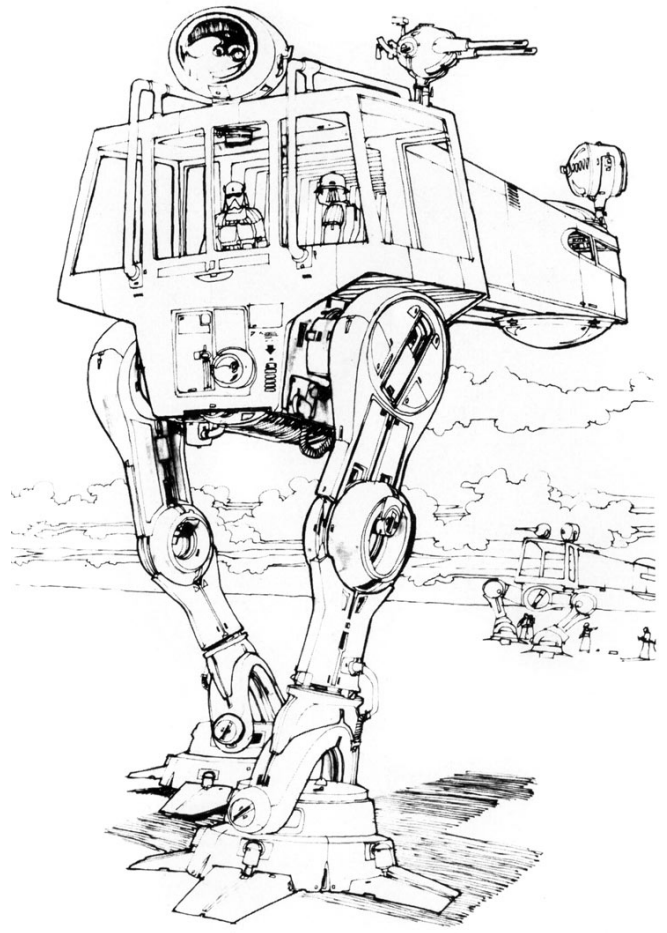
Dennis Muren sets up a shot with the biped scout walker featured briefly in the snow battle sequence. The animating surface was anchored atop a pipe rig and covered with white paper to aid in blending the model into the miniature snow sets.

“It was Lucas’ decision to have something more original-looking than a guy fitted into something,” the animator disclosed. “That was the final consideration, to get something that looked like a thing unto itself rather than an object that looked dead or artificial. The only way to do it was with a small model — stop-motion and motion control combined. Originally, however, they had intended to have *all* the taun shots be long shots. The thought was that we’d get as close to it so it looks okay, but that was their ‘out’”

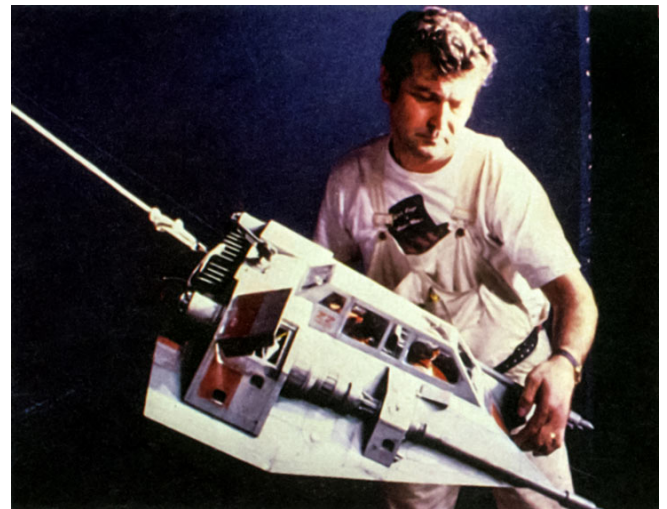
Tippett moved to San Rafael in September 1978. When he arrived at ILM, George Lucas was working on the taun design with Ralph McQuarrie. “Lucas was responsible for all the conceptions that ended up in the film. He would verbalize what he had in mind. Ralph and Joe would visualize it on paper, usually presenting a number of alternatives. Then George would approve one. He’s great in that he’ll go with the artist’s choice if he can and make only small changes. The taun was different, though. George wanted a two-legged animal that the rebels would ride on the ice plains. Joe and Ralph did a number of designs just to get the creature into the ballpark. Ralph’s conception was that of a big rat-lizard with a guy on its back. Joe came up with a more mammal-like creature that had hair all over it.”

“George actually told Ralph a few times to think of a big rat,” Johnston revealed. “He wanted a big rat-like snow creature. And as it turned out, Ralph’s sketch looked like a big rat with human legs! That design alone would have made for complications, so we were really glad to see that one go.”

As the *Empire* script gyrated, Tippett continued to sketch a multitude of hybrid creatures, each radically different from the other. “I did drawings of all sorts of things — frog-like things, things that looked like fleas, things that looked like dragons! Everyone had some input —Kershner and Kurtz, and especially George Lucas. They wanted to see a head that looked hairy with big talons on it — a grungy-



An early, larger concept for the scout walker, by Joe Johnston.



Most of the accompanying speeder elements were done using motion control, but for several shots requiring speeders to crash and explode, specially constructed models were rigged with pyrotechnics and shot high-speed on wires. Supervising stage technician T.E. Moehnke makes final adjustments for a bluescreen wire shot.

looking animal rather than a clean, manufactured-looking one. The English crew needed a final design of the taun while the script was being redone because they had to build the full-scale model and have it ready in time for production. I spent the good part of September refining the animal, and sent a design mock-up to England. They in turn sent back a mock-up with a number of practical and aesthetic changes. One of my final ideas looked something like a horse; the English crew added a long tail to it. I originally drew something with a very short tail; they wanted something that looked like a furry dinosaur.”

The tauntaun creature became the most intriguing element of the *Empire* advertising campaign, forefronting a *Gone With the Wind* love pose by Han and Leia. As the wanton beast of burden of the ice planet Hoth, it combined the body of a kangaroo with the head of a llama and the tusks of an ibex. Phil Tippett was pleased. “The tauntaun design we went with was basically mine. It was more of a mammal than the other versions. It was a big help to be able to build and animate a creature of my own design, one I could live with and work with for a year.”

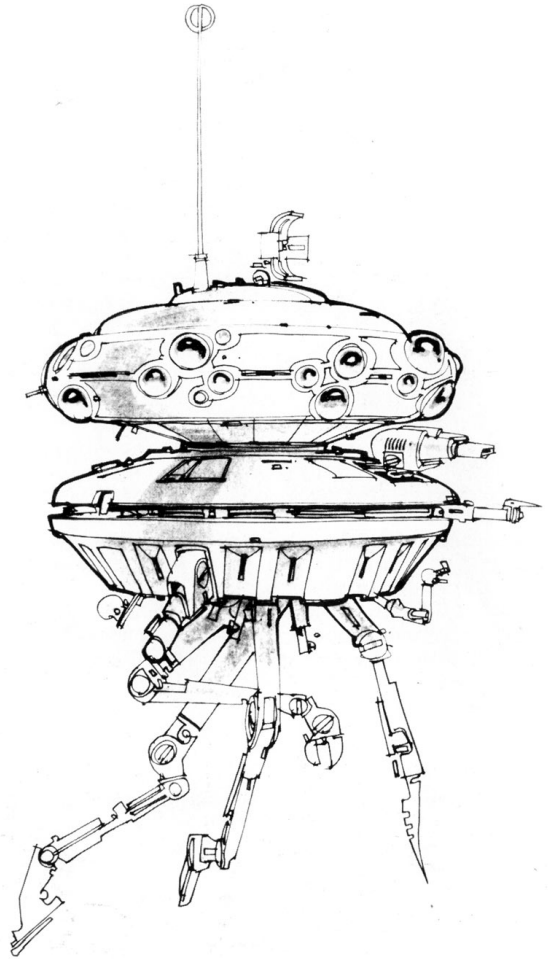
The full-scale tauntaun built at EMI-Elstree’s prop shop had its inherent limitations, but it cut well with Tippett’s animation once the movement came to a halt. The mechanism was basically inert in the film. Only in the ice hangar was it made to flaunt some of its capabilities by squirming nervously while costumed extras pretend to hold it down. Dennis Muren had his reservations about it. “I thought it looked pretty dead. They sort of goofed on the eyes. It was a very difficult job to do, and they were very rushed on it.”

Armature construction for Tippett’s tauntaun began in early summer of 1979. Doug Beswick built the legs. Tom St. Amand, who built it from the hips up, recalled its development. “We did build earlier — very quickly — a test armature as a preliminary model. I guess Jon Berg and I whipped it up in a week or two. Phil cast it in rubber, covered it with fur, and used it to do tests for a month or so. We were building the walkers at that time. Then Doug and I went back and made the final taun armature used in the film.” The Luke/Han puppet straddling the animal was built from a stockpile of existing joints.

Doug Beswick was doing work for another project in his San Fernando Valley machine shop when the phone rang. “It was about June of ‘79. Jon Berg called me and asked if I’d be interested in coming up there. At that time I wasn’t able to, but he had some work I could do at home, so I went up for a short visit. Jon and Phil showed me the taun, which I hadn’t seen before. They had this old armature which was well-deteriorated by that time, and a photograph of the taun that would be used in the film. There were a few sketches describing a basic idea of what was required for the armature. I came back to the Valley and built a wooden prototype based on those drawings which illustrated the dimensions of the model, where the joints were, and what did what. A month later, I flew back to ILM with it and they made some changes. I worked from that and from a cast of the actual taun. The armature I made was aluminum, because it had to be light — the taun had to stand on one leg.”

Beswick constructed the hips, legs and feet using a system of hinges and swivels rather than the customary ball-socket joints used in the test armature. Each system has its own advantages and disadvantages. Balls are omnidirectional but have a tendency to drift into a certain position during animation and freeze up, at times making it necessary to cut the puppet open and “break it free” by readjusting the tension and oiling the joint. So while a ball-socket armature works well when

properly engineered, it has a tendency to lock up in a knee or elbow. Swivels also have the same potential for locking up on the animator. Hinges are unidirectional and lack the versatility of ball joints. But they do produce extremely smooth movements and are ideal for junctures in the shoulder and hip areas. (Most of Ray Harryhausen's puppets are able to rear back using this system.) Adapting a hinge to a swivel makes for superb maneuverability — the hinge would move in one plane and turn on its base. This arrangement made the taun puppet easier to control. Many of the *King Kong* armatures built by Marcel Delgado were based on that principle.



Ralph McQuarrie did the basic design for the Imperial probe droid, or probot, an unmanned surveillance device used to locate the rebel stronghold on Hoth. Joe Johnston added finishing touches and refinements.

“My feeling is, that to be an effective animator, you really have to know what you’re working with and you really have to know the armature,” remarked Tom St. Amand. “You have to know in advance what some joints can do and what some can’t do. I thought the joint system used in the Joe Young puppet was excellent, but everyone might not think so. Sometimes things will lock up. If you noticed, Joe had swivels in the shoulders. Once they’d reach a certain point, they would lock. You could see some of those things in Kong when his arm was moving upwards, although in that case those were ball joints in the shoulders. You could sort of see the difficulties in bringing off some of Kong’s moves in certain shots. But you use different things. You might put some ball joints in there, if that’s what it takes. It’s really up to the animator. It’s up to Phil to say what he needs. You just have to be aware of what your armature can do — and Phil is; he’s very conscious of that.”

“For the taun armature,” added Tippett, “we used lots of things — balls, hinges, swivels, aluminum wire, whatever it took. This was interfaced with Tom and Jon all the time. What you use depends on the job. You have all this material, and it just depends upon what the requirements are.”

An interesting aside to Doug Beswick’s armature work for *Empire* was his building of the space slug seen during the asteroid sequence. “I returned to the Valley on December 2nd after the walker animation and took the rest of the month off. Then I got a call on January 2nd — they wanted more armature work done. It turned out to be the slug. They had a design as a wooden mockup, and I made it out of aluminum again. It worked like a hand puppet — a return spring mechanism would close the jaws. You could stick your hand through the neck and grab it like a handgun or a pistol grip. It was pretty heavy.” The slug was mounted vertically. Like the probot’s ascent from the crater, the scene required a small army of ILM workers. More than fifty takes of the slug were done over a period of a week, probably giving it record status for a throwaway scene. Phil Tippett covered the slug armature with an exterior of his own design, and Jon Berg puppeteered the first version for a number of takes. Tippett



A number of different techniques were used to film the probot. For the shot of it rising out of its crater, the probot miniature was mounted on a teeterboard and elevated by leverage. Joe Johnston and Dennis Muren discuss the logistics involved.



For another shot of it drifting across the ice plains, Tom St. Amand painstakingly animated the spindly contraption against a bluescreen.

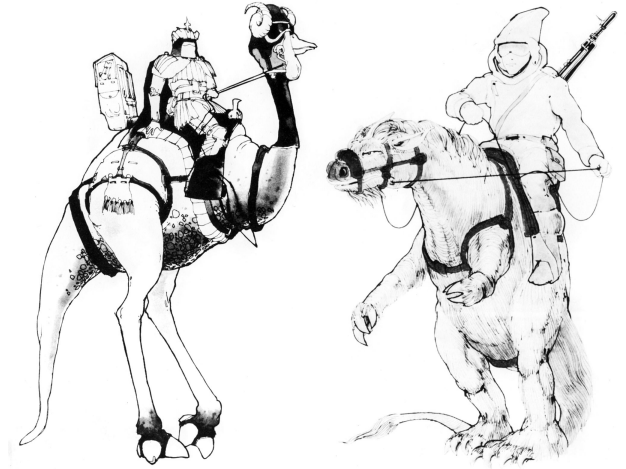


Still other shots were done live on location employing an eight-foot version of the probot suspended on cables.

also built a puppeteered version of the snow wampa that ambushed Luke and threw him off his tauntaun.

The final tauntaun puppet stood sixteen inches high. Only one was made. Tippett painstakingly covered it with calf hide. The armature operated like a well-oiled machine.

Though the taun was ready to be animated full-steam in August 1979, the process did not begin until January 1980. Most of the walker shots were filmed during this period, and though a few storyboarded taun shots were done prior to January, Tippett and crew had to redo them for one reason or another. "As it was, we got a late start on all the stop-motion work. Occasionally the camera's shutter would stick. This was due to the fragility and newness of the equipment. We might be shooting for six hours and find out that something on the camera needed an adjustment. So we'd approach a shot with a certain degree of hesitancy."



Joe Johnston and Ralph McQuarrie went through dozens of design concepts for the tauntaun. Early versions varied from ostrich-like birds to rat-lizard combinations to numerous other bird, insect, mammal and reptile hybrids. The final tauntaun used in the picture was designed primarily by its animator, Phil Tippett.

There are a dozen tauntaun cuts in the film. Each required a different setup. Of the twelve, five were done by animating the puppet against a bluescreen: the opening aerial shot, the taun entering the ice hangar, the run into the hangar, the one of Luke and the taun on opposite sides of the frame, and the scene of the animal running up to the camera as Obi-wan fades away in a blizzard. "That last shot was actually the first motion control taun shot where we introduced blurs on the puppet," said Muren. "I don't think it was entirely satisfactory. There were a lot of problems in tying down the puppet that couldn't be resolved during photography. There is a similar shot, though, of the tauntaun running up to the camera which *wasn't* done bluescreen. It's the best taun shot in the film, I think. So does George. It's a very bold shot. It starts off with the taun misted out way in the distance and it gets crisper as it approaches the camera. Finally it rears up. And the shot was 'right there.' All that atmosphere was done on stage during animation. We did superimpose a tiny snowstorm, but it was virtually insignificant. I think it was one of the most ambitious shots that had been tried." Light and weather phenomena for the most part were rendered with foreground lighting effects on glass and custom background diffusion.

Of the five bluescreen shots, the ones that proved most taxing to Phil Tippett were the opening aerial shot and the taun's run into the hangar where the speeders are being maintained. "They were horrible to shoot! Those were two of the longest takes. It's more difficult to animate in some ways in a bluescreen setup, because there isn't much relational material to look at. It's hard to look through the camera and get the feeling of what you're doing. It's more boring to do those shots on one level, but a lot easier on another level because you don't have to dodge all those tables and sets."

The first shot of the tauntaun was originally the first shot in the *film*. It was intended to be the “grabber shot,” as dynamic as the opening shot in *Star Wars*. After some thought, Lucas decided to start the film off in space. “I think that decision was made to remind you of the first film, and also to establish the source of those brilliant probes that race toward the ice planet,” suggested Muren. The reorientation was a judicious maneuver: for as it stands, the opening imagery, superbly augmented by John Williams’ Ligetian atonalities, preambles the snow scenes with a haunting mystical aura. Beginning with the star destroyer gliding past the camera, then proceeding to a breathtaking camera pan across its tail, flares careening into the ice, and the ascent of the probot, the eye-boggling vista of the tauntaun galloping across the tundra was re-edited to become the seventh shot of the show. It was clearly a matter of Lucas’ deciding not to flash his trump card outright.

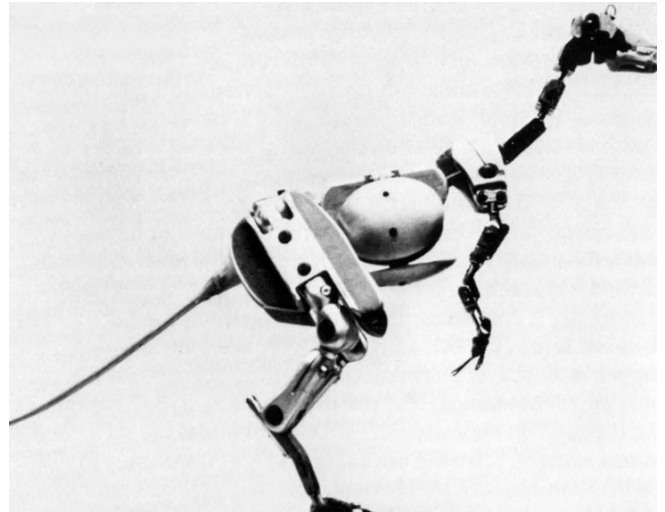
The tauntaun’s debut shot entailed more planning, more ingenuity, and more pride than any of its other scenes. As it appears in the film, the camera, from a helicopter’s point of view, swoops down on the running animal from an initial tilt-down of thirty degrees to a final one of seventy-five. The move therefore is over, down and in. At least it appears that way. A knee-jerk reaction is that the tauntaun is running on a miniature landscape, photographed with a motion control camera. Nothing could be farther from the truth. The shot was a concerted effort between the stop-motion crew and Sam Comstock of the roto department — the result of some truly inspired thinking. Baffling as it seems, the camera photographing the tauntaun was completely locked off for the duration of the shot. And according to Dennis Muren, everything worked the first time.

“When George Lucas suggested that we try this shot, I was thinking: Just how do we do it?’ I thought we could build a big model, but I knew it would never quite look right. I thought we might have to eliminate it and try to do another shot instead. But we did it successfully.

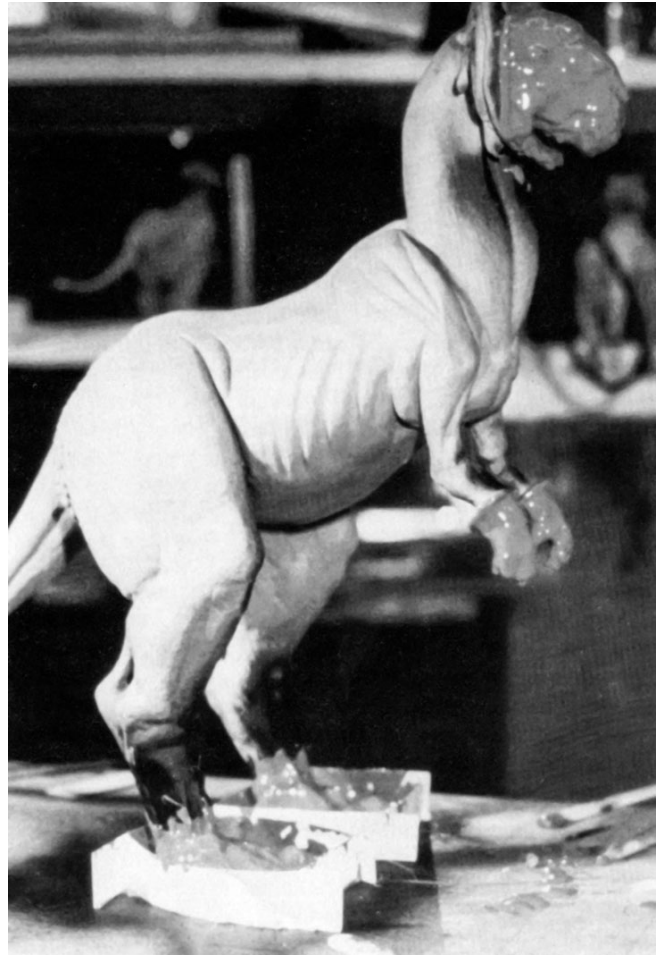
“I more or less got the idea from the work done on *Damnation Alley*. In a classic example of poor planning, the producers had shot this film with actors walking around in a desert and riding around in a bus-machine. All the exteriors were shot just like a regular movie, with camera pans, trucking shots, and so forth. Then they asked that the skies in this footage be *replaced* with strange clouds and lights! Now, we all know that camera moves on effects shots are hard to do, because each shot might have to be made up of four or five elements, and each element would have to move in precisely the same fashion. The producers of *Damnation Alley* didn’t know this, nor did they care to find out about it before making the film. Eventually, the effects team on that film came up with a clever way to do it, using an animation stand to plot each move of the original footage frame by frame. The footage was projected through the animation camera and onto the stand. They wrote down all the different positions for each frame, then later loaded the camera with raw stock, projected laser patterns, and repositioned them for each frame as necessary to match the background plate. It’s similar to rotoscoping for cartoons, but here you copy the camera move rather than the character’s outline.

“As it turned out, some of their shots looked great. In thinking about our tauntaun shot, I felt the repositioning was the problem. The helicopter footage had lots of bumps and vibrations. Instead of trying to reposition the plate on stage when we shot the puppet, I felt that we should move that obstacle to a comfortable environment. I once tried a shot in the first big episode of *Galactica* where the camera appeared to be racing toward the Cylon mothership. The background was taken from an airplane, and home base was supposedly sitting back there way off in the distance. The idea was to

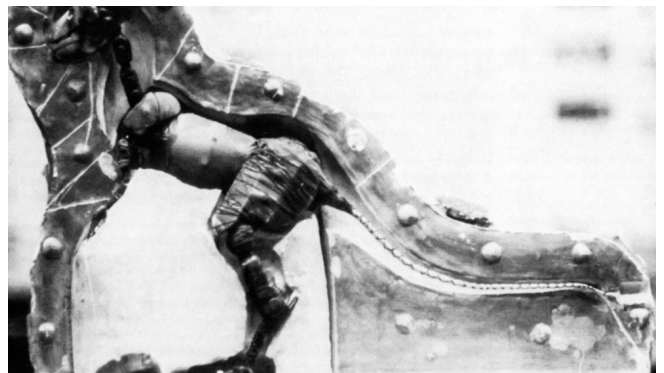
actually run the background film through the optics of the stage camera, reposition it a frame at a time, and record the repositioning for each frame in the camera's memory unit. Once all the moves were calibrated, we unloaded that plate, ran the memory back to the start of the shot, loaded the camera with raw stock, and shot the Cylon base. The photography of the model was supposed to match the bumps and jiggles of the airplane shot. But it was just *impossible* to view anything accurately through the stage camera for repositioning. It just wasn't the right approach. The experience was still fresh in my mind when our helicopter tauntaun shot evolved, so I decided to shoot the puppet *full frame*, which made it easier for Phil to animate and for us to shoot. Then the difficult part went to Sam Comstock, who was sitting in an air-conditioned room and could spend a few days on the repositioning while sitting down. We'd give him the biggest projected image he could deal with to help eliminate the chance of anything going wrong."



The armature for the tauntaun was built to Phil Tippett's specifications by Doug Beswick and Tom St. Amand.



Castings taken of the head, feet, and arms of Tippet's sculpted clay figure were used in the preparation of a master mold.



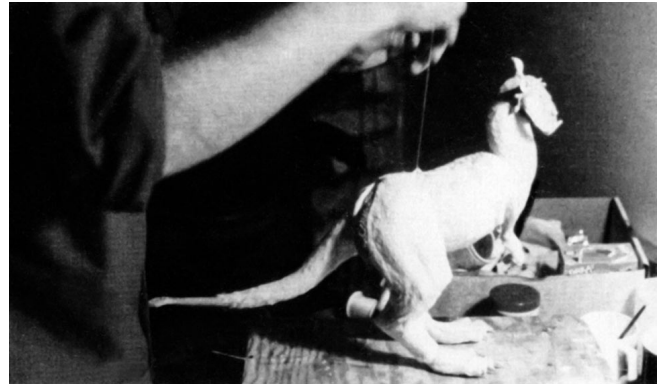
Once completed, the mold was used to cast the puppet in foam. The armature, wrapped in thin sheets of latex so the foam would not penetrate the joints, is in place.

“Actually, I was standing up and leaning over,” quipped Comstock. “I wasn’t in a lounge chair. I had to recuperate for a while after that situation. But I suppose it was better air-conditioned than the other part of the building!”

The Oxberry animation stand was something new at ILM. The old facility in Van Nuys did not house one for *Star Wars*. As key animator for an educational television outfit in Kentucky, Comstock had been in charge of the master series Oxberry. His experience on that machine was instrumental in his being hired by Peter Kuran for *Empire*.

Like Dennis Muren, Comstock was also influenced by the eccentric work done for *Damnation Alley*. “The sequence I remember particularly was a shootout between the good guys and some desert characters. It was shot western-style, characters running over hills and chasing each other behind rocks. The cameraman would pan along with the people as they ran across the scene. Later on, someone decided that the sky needed to be ablaze with pyrotechnic effects as part of the aftermath of a nuclear holocaust. Someone had to take the elements of the effects and match them to the camera pans. There were many matched moves in that film; and as I watched it, I remember groaning to myself, thinking about all the labor that went into it. It was all done after the fact.”

To get this *tour de force* taun shot rolling, Comstock began the matched move process by plotting a helicopter plate. “The background was one that George picked out. He said he’d really like to see the tauntaun fitted into that particular scene. We all rolled our eyes a bit, because it was obviously an unusual plate to have to fit something into. Fortunately I had already done those cockpit shots with the miniature walkers, so I had some practice in matching background moves. Dennis approached me and asked my opinion on how I might contribute to the shot. Both he and Phil knew from the start that this was going to be a very difficult shot, no matter *how* it was done. There were a number of discussions and a couple of other plans along the way. One was that there would be more of a compensation as the tauntaun was shot, which primarily had to do with the truck-in and angle change. There was also talk of making new equipment and doing more meticulous work during the tauntaun photography. All those taun shots were tough to do at their simplest. But this one required extra compensation, making it a particularly difficult shot to do. What I did on that shot has an added dimension, because the taun itself had to be traveling across the ground. In isolating the move of the helicopter footage, I made the Oxberry do a miniature version of that move.”



Calfskin was carefully fitted and handstitched onto the foam puppet.



With a similarly-constructed rider, used to represent both Luke and Han, already astride the saddled tauntaun, Phil Tippett gives the model a final trim before it goes to the shooting stage.

Comstock went through the plate chosen by Lucas and studied it several times. His goal in this instance was to plot the entire move before the tauntaun was animated in order to figure out the appropriate size for the taun in the frame, and to calculate the precise angle change for the “over, down and in” movement. Phil Tippett would then know when to introduce the tilt onto the bluescreen taun element. That element, shot in full-frame Vista-Vision, would in turn be supplied to Comstock. Following his own calculations, Comstock would then rephotograph the animation and create the entire “zoom-in” movement by moving the Oxberry camera down onto the exposed frames in incredibly small increments. By the time the Oxberry had reached the tightest point on the taun, the tilt/angle change would have automatically occurred since that particular move had already been done on the stage. In the end, two pieces of film would be available — the helicopter plate and a matched-move bluescreen taun element containing the “over, down and in,” ready for compositing.

Calculating that move on the Oxberry was half the battle. “The first thing I had to figure out was the zoom-in. It’s really a *truck-down* with the camera onto the bed. I was taught in school, though, to call it a zoom in order to differentiate it from the trucking in of the *bed*. So it was really a ‘truck-in.’ I did that first just to make sure that I had the downward movement of the Oxberry camera secured. All the side-to-side (x and y) movements were figured out afterwards frame by frame. I was very lucky that there was one rocky blemish on the helicopter plate as a reference point. Since it was a roundish spot in the snow, I also used that to help figure out the angle change as it diminished into an ellipse. Actually, I started plotting *tight* on the plate and moved the Oxberry camera backwards up the column, a fraction of an inch per frame. That was done just to figure it out. When it came to actual rephotography, I shot it moving in.”

It took Sam Comstock several days to plot the move. Plotting was done twice, and the two were averaged out. In order to get a better handle on the shot, he drew a small representation of the tauntaun on a cel and shot a test with the camera move to see how it would fit in. “The artwork was just a little white shape with a black shadow drawn under it, and I moved it at the speed calculated for the taun’s running cycle. I figured it was worth doing. Had we gone through all the steps and sent it to the matte department, only to find out that the move was inappropriate, it



Working from Phil Tippett’s design, the studio art department in London constructed a full-size tauntaun for closeups with the actors. The eight-foot taun could rear back, blink and snort carbon dioxide vapor, but was incapable of forward motion. Sitting astride the mechanical tauntaun, Luke Skywalker (Mark Hamill) surveys the icy wastelands of Hoth.



The stop-motion tauntaun with its miniature rider.

would have been a great waste of time. I had the cel printed with the background plate to roughly see how it would look. When that proved satisfactory, my calculations were given to Phil and actual animation of the tauntaun began.”

The whole point of this operation was to keep the stop-motion camera locked off for the entire shot, and to avoid the cumbersome mechanics of an inherently complicated motion control shot by routing the work to a more comfortable environment. Not only did this make it easier on Phil Tippett, but it eliminated a myriad of other problems, as explained by Dennis Muren. “Moving the camera onto the taun was one of the things that had been suggested in the beginning. But there wasn’t any *point* of us moving the camera. That would have only introduced all sorts of bumps and shakes. It was so much easier to have Sam rephotograph our daily print. And that was exactly what was done.”

During animation, the tauntaun model was suspended in space against a bluescreen, held by a rod that went back to a blue pylon. The whole support was mounted on a heavy duty rotary table from a milling machine, a device normally used to hold pieces of metal in place during the cutting process. To create the tilt during animation, the whole assembly was tilted. “That was a lot easier than trying to do a large curving move with the camera,” explained Comstock. “It wouldn’t have simply been a tilt in the camera, though. The camera would have had to stay the same distance from the taun. It would be like traveling in the arc of a circle around the setup, the center of which would be the line of travel of the taun. It turned out to be much easier to rotate the tauntaun around the line of action.”

Of course, the credibility of such a shot lies not only in the invisibility of the matte line, but in the ability of the puppet to cast its own shadow. There are several ways to approach this, depending on what technique is being used. One of the niceties of Harry-hausen’s Dynamation process, for example, is the ability to create the illusion of a puppet’s shadow by mounting a cut-out of neutral density material behind the process screen and aligning it with the puppet’s foot just above, or below, the split screen matte line. That is basically how a cyclops was able to cast its own shadow on a rear-projected beach. Another, much simpler, way is to anchor the puppet to a piece of miniature foreground, enabling it to cast its shadow naturally. The majority of tauntaun shots fell into this category, since the animation took place on miniature snow sets.

The tauntaun bluescreen shot was obviously a different situation. In order to create its shadow, a white card was slid underneath the puppet and shot on alternate frames. “We had a number of discussions to figure out the best way to generate this,” explained Sam Comstock. “The frames containing the shadow were transferred to a separate strip of film as I rephotographed it on the Oxberry. It was actually the shadow of the tauntaun which had been garbage-matted and isolated onto black-and-white stock. What I shot was a *white* shape on a black field. Optical had supplied me with a negative of the shadow element. That way, I could black out the periphery of the shot with a garbage matte and keep the room darkened. In the end, the shadow was essentially part of the holdout matte for the taun.”

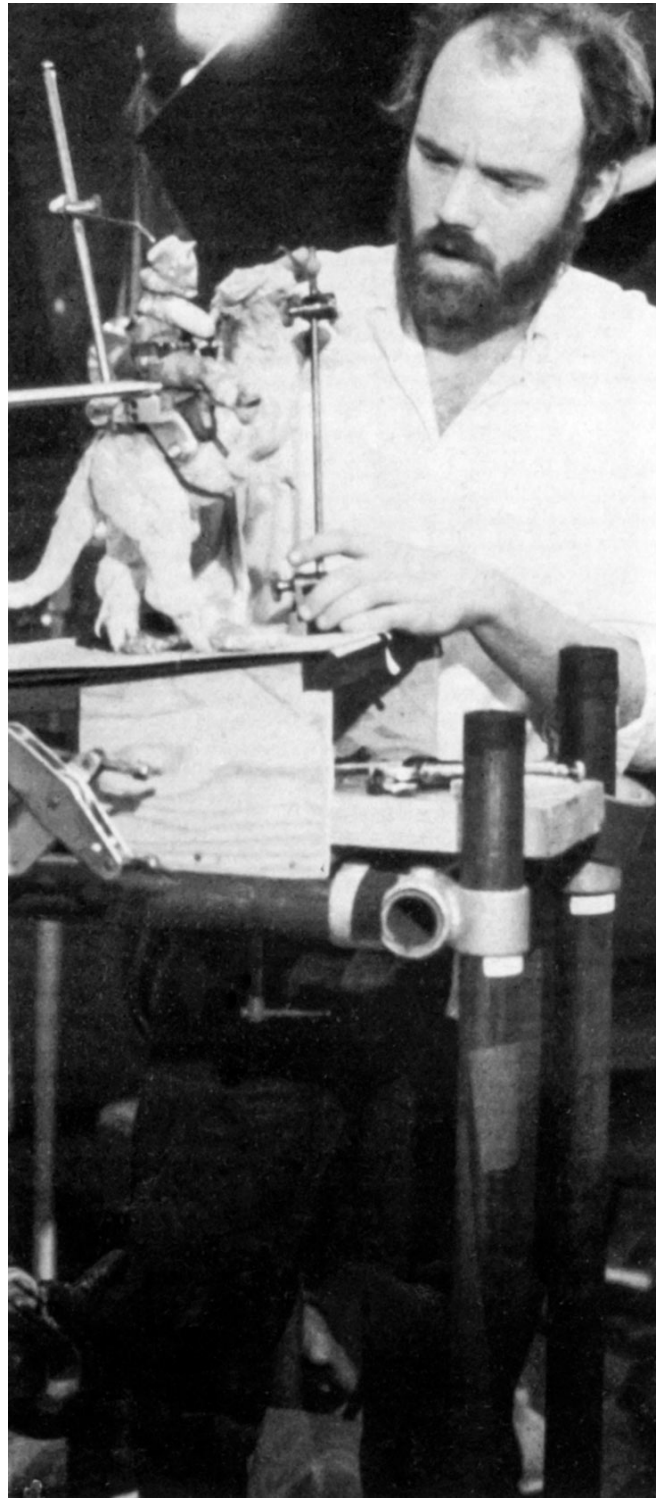
Another consideration was the contour of the shadow itself. Placing a key light above the puppet produced an exact shadow on a white card which, in perfectionist terms, precluded the amorphous qualities a shadow would naturally have on an irregular surface. “We considered doing something

about that,” said Comstock, “because the snow was kind of bumpy and ribbed. But we decided instead to resort to a soft shadow, because it would never really match the bump of the snow surface. The shadow was distant in the shot anyway, so it really didn’t matter. There would be a chance of a mismatch had we decided to make the shadow wiggle around. Even at the end of the shot, it’s still pretty small in the frame.”

Completing his work on the Oxberry, Comstock copied Phil Tippett’s actual VistaVision frames by placing them on a pin block (a piece of metal with registration pegs) over the light box of the animation stand. “It paralleled the way film is copied in an optical printer. The camera was pointing directly at the piece of film, copying it rather than a projection on a ground glass screen. Grain problems were insignificant; the main worry was contrast. We generated a garbage matte, since the plate was only a tiny part of the frame. And because the tauntaun was so small in the frame, there was plenty of room to truck in. The tightest field size for the ‘zoom’ was still sixteen inches across. In doing this, I had to accommodate the angle change when the helicopter came in close and started looking down on the taun. There was about a thirty-degree angle change during the first section of the shot. I felt pretty daring, putting in that much time and effort, not knowing what the outcome would look like. I think I figured out that actually calculating the move from the background plate took sixty-five hours. The shot only ran a little less than ten seconds.”

Comstock recalled the atmosphere that prevailed in the projection room when this dramatic shot was screened. “Actually the first try on that was just the holdout matte by itself against the background, to see if the move worked. We were all surprised that it worked out so well, even with just the holdout and its shadow. It looked so strange, seeing this little black object running across the snow. His feet stayed right where they were supposed to be. It was a real thrill! George and Gary were pretty pleased. George doesn’t often get overly demonstrative and usually expresses his approval with a sincere ‘Great’ if he likes it. He seemed fairly happy with what he saw. Phil and Dennis deserve a lot of credit for that. I don’t think the shot provokes too much comment with audiences, though. Perhaps it’s the naturalness of the shot, the effortless run of Phil’s animation, and the invisible work by the roto and optical departments that yields acceptance without question. Maybe we should have put a matte line around it, just to draw some attention to it.”

Dennis Muren offered his own assessment. “There are a lot of reasons why that shot works. It works because the taun is always moving. Because it was shot bluescreen, it didn’t have to lock onto the ground. Any major bumps or drifts had to be there, but it isn’t tied down. If the taun stopped halfway through the shot, though, we could see that there would be some instability going on. It turned out at the time that one of the main axes of the Oxberry had a lot of play in it. I don’t think Sam was aware of this when he shot it, but it wouldn’t repeat exactly. This influenced the result and that of other shots in the show using the same technique.”



Phil Tippett animates the tauntaun on an incline.



One of the most difficult shots to achieve was the opening scene of the tauntaun running across the snow. The snowy expanse was shot live from a helicopter and the stop-motion miniature had to be photographed against a bluescreen and matted into the constantly-shifting background plate.



Phil Tippett animates his tauntaun for the shot in which Han dismounts to search for Luke.

(The shots Muren alluded to were three matched moves Comstock did of the cloud city. The aerial shots were rephotographed on the Oxberry, together with several small cloud city paintings done by Ralph McQuarrie on acetate cels, using the front light/ back light matting technique. Comstock's situation here was similar to the one in which he realigned a moving plate for compositing with the tiny walkers. "Cloud city was a real bear. That was actually the most difficult matched move to do. Just because the move wasn't very pronounced, the tiniest vibration in the cloud plate made it obvious that a city was being added later. And as Dennis pointed out, there was some backlash in the animation bed which resulted in some minor inaccuracies.")



Dennis Muren adjusts the blue pylon mount for the opening tauntaun scene. For this shot, the camera remained locked off while the entire model assembly was shifted in position to duplicate the helicopter camera move. For each tauntaun move, two frames were exposed — one for the basic bluescreen element, and one with a white card underneath the model (shown here) for the shadow effect. The two were then separated out in optical.

While the tauntaun helicopter shot may have gone over the audience's heads (no pun intended), few could claim obliviousness to the scene of the animal running straight into the ice hangar. Tippett's animation is so fluid it almost ceases to resemble stop-motion photography. The shot is a minor miracle when one stops to consider that the tauntaun is matted onto a background that has everything but hail in the atmosphere. Dennis Muren remembered his own bewilderment when the request was tossed before him. "All of a sudden there was George saying, 'Hey, we want a tauntaun to run into this shot.' Just looking at it, I was wondering how it was going to be possible, because there was haze in there, lens flare was going on, there was no place to put a split screen, and where would you place the ground, and *would* you use a miniature ground? Also, there were these two pools of light which made it even more difficult. It was a real challenge — that and the helicopter shot. There were a number of other great shots, but those two were outstanding. My first thought was, 'I don't know how we're going to do this!' But in both cases, the solution came quickly. After about a day or so thinking about it the answer was there."

Instrumental to the success of both shots was the selection of matting stocks and the sacrifices that had to be made in order to eliminate the matte line. For the most part, 5369 Kodak high-contrast stock was rejected in favor of 5302 (Kodak black-and-white release print stock) and 5235 (separation stock) for matte generation. Requirements for individual shots were carefully coordinated with optical supervisor Bruce Nicholson and Warren Franklin on optical lineup. "The high-contrast stock produced a hard edge," Muren explained. "The other black-and-white stocks were much better. But the *trade-off* was the transparency. To get rid of the matte lines in the ice hangar and the helicopter shot, we settled for a bit of transparency. I don't know if it's evident in the release print, but in the original negative, you could see the lights ghosting through the tauntaun as it runs onto the landing strip. That was far removed from a high-con matte. Had we gone to that stock, those shots would have been totally unacceptable. The trick to the hangar shot was its brevity; the taun's run-in was just quick enough to give that impression." Interestingly, Sam Comstock had originally plotted the

move of the taun to run in *front* of that rocky blemish in the helicopter plate to enhance the credibility of the scene. But because of the matte's delicacy, the move was shifted to a position above the rock to avoid ghosting. Transparency on the lower half of the tauntaun was intentional, however, for the scene of it running up in a blizzard and rearing up, to marry it better with the foreground and background snow effects.

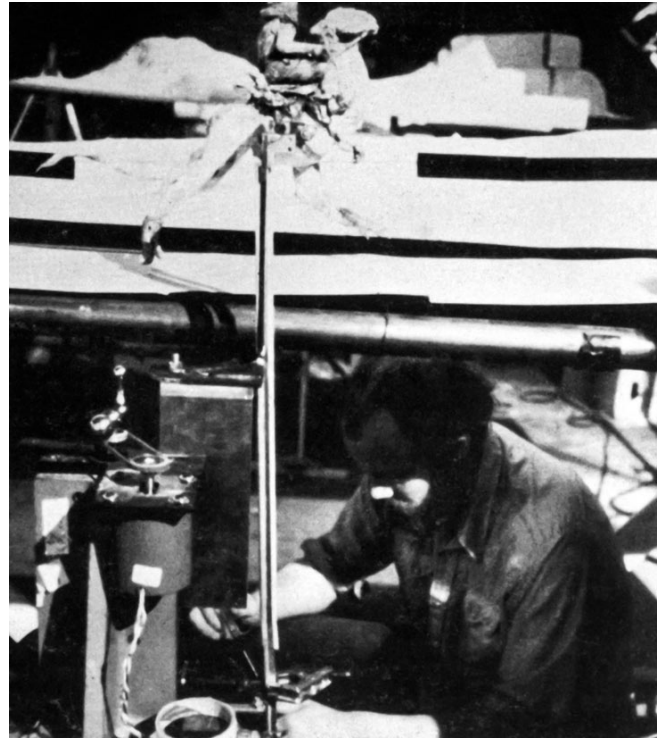


The tauntaun running into the ice hangar was shot bluescreen, with a number of complex lighting changes and diffusion effects to match the live-action stage photography.



Assistant cameraman Jody Westheimer prepares for a tauntaun shot. The rod assembly affixed to the camera-away side of the model is part of a motion control rig used to blur the running puppet.

Another trick was the discriminative use of blurs. Blurs were generally avoided in bluescreen situations because of possible mismatch between the matte's edge characteristic and that of the blurred element. "That was violated, though, depending on how dark the background element was. We blurred the taun for the shot of it running into the hangar, despite the fact that it was bluescreen. We were able to get by on those, because if we were getting a matte line, it probably would not be as noticeable as it would be against a light background." Appropriate diffusion was added to the taun element to make it compatible with the vaporous background filmed in England. The preceding shot of the animal entering the hangar in profile was enhanced via glass art rendered by Ralph McQuarrie. No other taun shot, though, could boast the *chutzpah* of the ice hangar sprint. Quite naturally, it cruises down the center of a landing strip replete with spotlights and looks as though it were right at home.



Phil Tippett adjusts the motion control mechanism.

Sam Comstock was once again engaged to provide a shadow element for the feet. "They didn't do the actual shot at first. They put the taun through some dry runs. The puppet was attached to a rod and slid along on the motion control track — there was no stop-motion involved in this instance. The lighting setup approximated the one that was needed. A white card was placed under the taun, and I used that film as a guide to get the shadow's angle and shape. Later on, I drew the shadows on cels to match the movements of the puppet."

Phil Tippett animated several other dynamic taun shots, including one where the animal drops dead with the greatest of ease. "We'd go to dailies," remarked Comstock. "Once in a while a tauntaun shot would come up and everyone would get knocked out of their seats! And this was just a *daily* — it hadn't gone through optical yet. And if you really want to look for details, look at all the little bags and packs hanging on the taun — they're all bobbing up and down. Phil did an amazing number of little details for that thing. Luke is also bobbing up and down as the taun breathes and gallops. Just incredible stuff! I remember that around the middle of one shot the tauntaun ran behind a hill. Everybody took the opportunity to grab a long lunch break."

"In the early stages, we didn't know how well the taun was going to work, because it had to run," Tippett admitted. "Pushing a puppet that far per frame was asking an awful lot. Many of the basic running and body moves were almost an inch-and-a-half, which would have resulted in a very stroby image. So we took measures to overcome that strobe by blurring the legs of the puppet. At the time, we weren't certain as to how it would actually work out."

Just how were those blurs introduced? “It’s a secret,” he said. “It was just a matter of having an open mind and access to equipment.” Nobody would talk specifics, but it was revealed that a series of motors were employed which produced incremental moves during exposures. They were, in effect, motion control puppets. “The equipment that we ended up using can now be purchased off the shelf for about four thousand dollars,” Muren divulged. “That system can be duplicated; it’s not like there are only two places in the world to get it. I think it’s interesting to recognize that the sophistication of the equipment used for the space shots was far greater than that of the equipment needed to introduce blurs on the puppet.”

Because of the tauntaun’s broad, cyclic stride, the question was posed to Phil Tippett as to whether he ever considered fabricating a series of replacement puppets. That system calls for the sculpting of individual nonarticulated puppets for a sequential number of frames and replacing each puppet per frame in order to provide a cyclical movement without resorting to articulated models. The last feature to use this system was *The Beast of Hollow Mountain*, a film notorious for cutting directly from some of the most atrocious animation ever done to one of the smoothest gallops ever — a gallop achieved by using replacement puppets. “We may have considered it briefly, but it would have taken too much time. It would take so much production just to get a cycle; and once you’d get one right, you’d be locked into it, which would prevent you from changing something. For the time we had, we weren’t able to experiment with an adequate replacement series. I don’t think it would have looked as natural, though.”

Several taun shots became casualties of the cutting room. “There was one shot that we weren’t quite sure if we were going to be able to fit in because of time,” recalled Tippett. “I believe it was the second shot of the taun. We worked really hard to get it. It was a side shot panning along with the puppet. It was actually twice the length as we see it now, but it was edited down. We were trying to do a long panning shot of the sky across the plain. For one reason or another, they didn’t seem to think it worked running full length.”

Dennis Muren revealed the details of a far greater loss. Phil Tippett had animated an elegant medium long shot of the Han puppet astride his tauntaun entering from screen right. Han tossed one of his sentry markers into the snow, turned the taun around, and galloped out of frame. It was done in two cuts using the same setup.

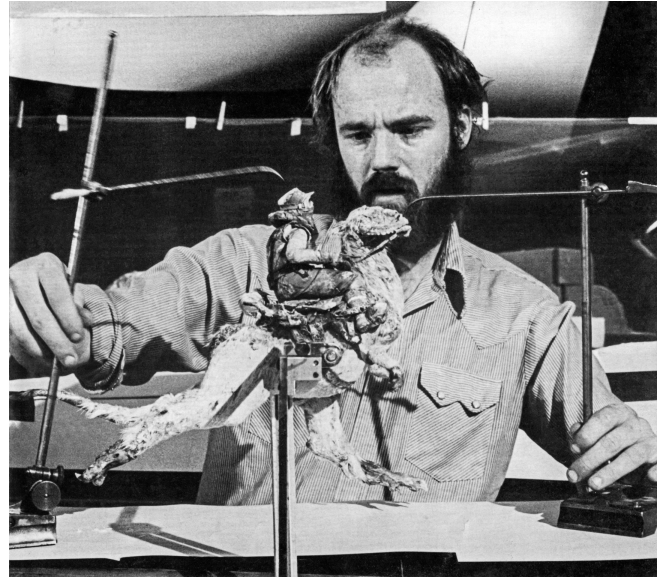
“The shot was beautifully animated. The blurs on the puppets were the best you could ever see! When you looked at the screen, Han and the taun looked absolutely real. It was probably the nicest animation Phil had done for the film. But the *shot itself* didn’t look right; there was something about it that didn’t look real. We never managed to solve it; and it didn’t cut well, either, because the camera was too close on the taun. What George really wanted was a *long shot*, so we quickly did a replacement shot of the animal running off way in the distance. Phil spent two full days animating the first one. It took a long time to set up and we had a beautiful background for it. But it just didn’t work out.”

Pictorially, *Empire* took an odd leap when the film segued to the bog planet. Atmospheric sets and matte paintings evoked the déjà vu of Skull Island and the moody tableaux of Fritz Lang's silent *Nebelungenlied*, where gnome-kings roamed and fantastic lifeforms crept out of the mist. Some of this may have influenced George Lucas' thinking, as evidenced by the Yoda character. One early rumor was that Yoda had been considered for stop-motion. "We never heard that," said Tippett. "What we saw in the script was pretty much what we were responsible for, which was the taun and the walkers. Later on, we were able to add certain things like the birds in the swamp. I felt that something should be put in to make it look as though other things existed in there."

Ken Ralston animated the bird elements. One bird was used, mounted on a pylon against a bluescreen. The model was animated in several takes, all of which were composited together in the printer. The beauty of the bluescreen system allowed Ralston to give full attention to each bird pass, thereby eliminating the confusion of animating several

models at one time. Blurs were introduced on the wings. In the first two cuts, the bird takes were composited with matte paintings of the swamp by Harrison Ellenshaw. Ralston's bird animation added life to the two remaining scenes of Luke trying to raise his speeder out of the bog — subliminal images akin to distant seagulls on an ocean horizon. "George hadn't planned on putting anything in those shots. Phil convinced him to go with something unusual. In fact, they were going to go with something even *more* bizarre, a creature sitting in the water. But there was simply no time to do that. The birds shot may have looked like something Willis O'Brien would have done, but you could put a camera 'out there' and put birds into it and say it looked like anything it reminded you of. I had specific rules that I had to follow — to liven up the area and make it look even more strange. The only other lifeforms were the familiar lizards and snakes slithering around. The birds made the swamp look more alien. Phil built them. They had alligator heads! They were very strange-looking things. But that shot was done — just as many were — by having the motion control equipment on hand, getting that first bird to come in and glide by along with the body movements and wing flaps."

With all this technology available, one wonders why a master like Ray Harryhausen stays sequestered with complicated, unstable aerial rigs for flying dimensional objects. For shots requiring little or no interaction with live-action elements, suspending a model on a network of piano wires would almost seem masochistic when compared to the stability of a puppet locked onto a pylon. Modern advances notwithstanding, Harryhausen remains unchanged. "Ray is set up



During animation, Tippett would position the tauntaun puppet into its desired stance for each frame. Then, while the frame was being exposed, the motion control mechanism would move the model a short distance down a concealed track, introducing a blur on the photographed image which helped eliminate the strobing effect characteristic of stop-motion work. A white card covered the camera side of the support rod, and for each frame, the intensity of the light hitting it was adjusted to blend in with the miniature setting.

to do it with a system that he knows really well,” Ken Ralston commented. “If he tried to operate in our fashion, it might be a big mess. Not everyone has the ability to create a system like we have. And not everyone is going to sink a lot of money into creating such a system for most films. The realities of budget, that’s the main concern.”

“It’s all a matter of trade-offs,” added Muren. “On one hand, bluescreen works well; but as I mentioned before, it wouldn’t work for the walkers. The blurs on the birds looked terrific; but if you matted them onto a light blue sky, they might look bad. Each shot has its own pros and cons. The trick and the talent lies in your ability to recognize that in advance. You don’t go into something and blindly shoot it one way and it screws up, and then try it another way and it screws up again. It’s recognizing how to do it in the beginning, and clearly going in and doing the shot. There’s a school of thought that says you shouldn’t switch between one technique and another because they won’t match. I don’t think that’s right. It all depends on what you want to get out of the shot. If you stick to one method, it’s not going to work as well for some shots. So the idea is to compromise at the start by saying that some shots are only going to be as good as this one technique says we can do. The other approach is to lock into one technique in order to have better control over a sequence. Then, if you can get a better result doing something different for a few specific shots — try it! But *bring it up*; make it compatible with the other shots so it cuts in smoothly. That way, you can have all the advantages of whatever bluescreen gives you or what painted backgrounds have to offer.”

The bottom line of this entire operation is that stop-motion animation is alive and well at Industrial Light and Magic. George Lucas stands as the personification of every hope and trait today’s creators of special effects have yearned for — something that proved untenable in Hollywood. To all concerned, ILM is a fertile garden in which new ideas are planted and innovations are harvested. With *Dragonslayer* and the third episode of *Star Wars* in the works, unusual and exciting illusions are already germinating on the horizon. “George had at one time planned some other stop-motion ideas for *Empire*, but he couldn’t write into it,” revealed Dennis Muren. “I think these ideas might turn up in the third film. Right now, it’s all very speculative.”

The Empire Strikes Back has taken stop-motion out of its doldrums by giving it a chance to titillate rather than overwhelm. But even more significant is the puncture it has made in the stereotype of the single effects artist toiling away for months in a cloistered environment devoid of humanity, and having to be responsible for virtually every phase of input. The last stop-motion adventure film to take the beehive approach was *Mighty Joe Young*, up until now looked upon as an outrageous *bravura* event blown away by public adulation over individual prodigies. While a crew of twenty-five crafted miniatures, set up lights, loaded cameras and developed hand-tests, O’Brien sketched, Harryhausen animated, and General Cooper cracked his whip. George Lucas remains a tamer sort, but the *gestalt* of Stage One on the RKO-Pathe lot thirty-three years ago is something everyone at Industrial Light and Magic can relate to, especially an animator like Phil Tippett.



Dennis Muren studies the tauntaun runway in preparation for a shot.



For bluescreen use, the tauntaun was mounted on a fluorescent pylon which blended in with the background blue so a clean matte could be extracted from the model.

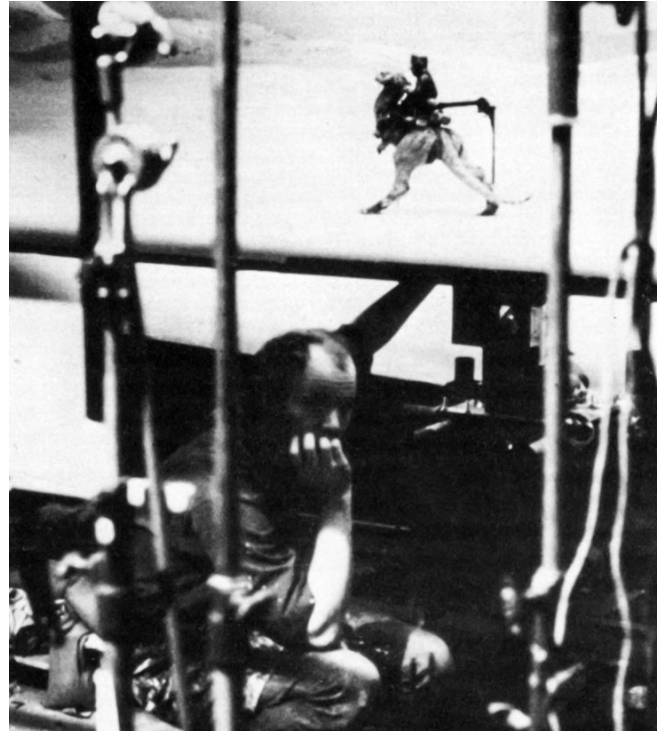


Ken Ralston animates the reptilian bird-creature which flies through several of the bog planet scenes.

“One of the things that working up here affords us is the ability to specialize in one area, work out the bugs in that area, and interface with other people who are specialists in their own fields. It was good working with Dennis, who set up all the lighting and sets, insuring that all those operations interrelated to the story. I was mainly concerned with animating. But at the same time, there were other jobs that would overlap. Our fingers were in everyone else’s work. So while everybody was a specialist, we each had a good idea of what was going on around them. It was really nice to have that type of situation set up; whereas when you’re on your own trying to animate, shoot, and improvise everything, the pressures are overwhelming. What was most interesting about the project was the large group of people all working toward a common goal. We learned how to do this during the course of the film, and it wasn’t easy. Most of all, we were allowed time to develop and refine; and we were treated with respect. I felt that was one of the greatest attributes of working on *Empire*.”

Ultimately, it seems, stop-motion animation has gone full circle while continuing to circumscribe its own orbit. Despite the presence of fluorescent bluescreens and techno-studded camera systems, the environment for the snow walker sequence was one in which Willis O’Brien would have felt right at home. With a reverent nod to his early influences, Dennis Muren speaks for himself and his crew.

“We all owe a lot to Willis O’Brien for his setup designs, his energy, and the rich heritage he established generations ago. Ray Harryhausen’s imagination and success in this difficult field kept me and the others going when we were younger. Jim Dan-forth’s excellence and continuous striving for improvement with every shot influenced me to go beyond anything we’d done before. Jim and Dave Allen provided all of us with hours of dialog on stop-motion, effects, color and quality during my days prior to *Star Wars*. And Phil Kellison at Cascade



Concealed from view while the camera exposes a frame of film, Phil Tippett awaits his next move.

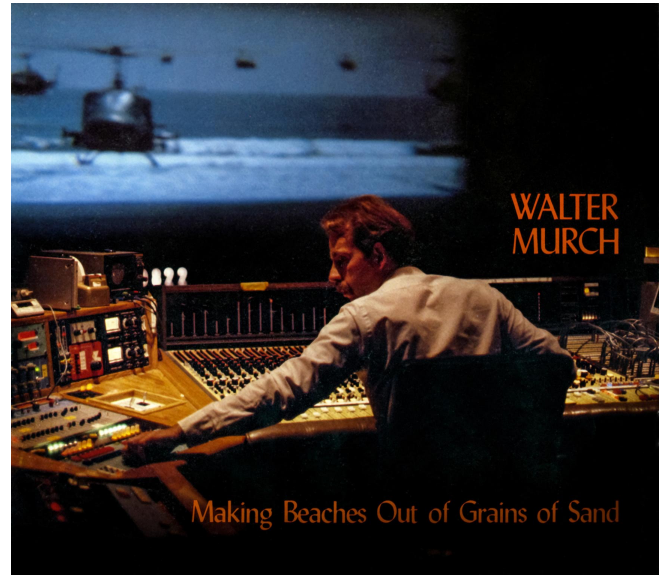


Many of the snowstorm effects were produced in-camera using foreground glass paintings which moved on tracks from frame to frame.

Pictures laid out an environment blueprint for setups and problem-solving that proved invaluable as each new project evolved. That's quite a background for all of us to draw upon."

Paul Mandell is a film journalist and dimensional animator living in New York City. Graduate of Brooklyn College in film production and New York University in cinema studies, he received an American Film Institute grant in 1974 and recently co-animated four segments of puppet animation for the Children's Television Workshop. A contributing editor of Fantastic Films, his work has appeared in Filmmaker's Monthly, Cinefantastique and Starlog. After years of research, he is currently completing The Fright Factory on Universal thrillers, and The Making of Mighty Joe Young, the definitive work on his favorite fantasy film.

The Empire Strikes Back photographs copyright © 1980 by Lucasfilm Ltd. All rights reserved. Special effects unit still photography by Terry Chostner and Howard Stein. Conceptual illustrations by Joe Johnston



WALTER MURCH

Making Beaches Out of Grains of Sand

article by
Jordan Fox

First the jungle ... cool, a soft green in the early morning light, strangely inviting. Then a subdued whir of rotor blades crossing over the periphery of the frame. Abetting the hypnotic imagery, a sinuous lead guitar flows hauntingly onto the soundtrack and singer Jim Morrison's doom-laden lyrics snake through the long lap-dissolves, tying together the motif of helicopter blades with the whip of a ceiling fan in a grungy Saigon hotel room where a young but hardened Army assassin confronts the demons of his own drunken daymare. *Apocalypse Now* is about to take us on a journey into the heart of darkness, where striking revelations await our ears as well as our eyes.

The sonic innovations present in this film (by far, most evident in its 70mm "flagship" run) do not call unseemly attention to themselves, but their contribution to the film's realism and overall impact is incalculable. They are the work of Walter Murch, the master sound mixer who made a similarly crucial difference in three other landmark films: *THX 1138*, *American Graffiti*, and *The Conversation*.

Dusty cliché though it may be, one expects to find Walter Murch a man immersed in abstruse technical detail, on the laconic side, and not terribly adept at making his field comprehensible to the uninitiated. Nothing could be further from the truth. Walter Murch is articulate to the nth degree and readily able to suggest whatever apt comparison or metaphor is necessary to get his point across. Far from being an electronics wizard or acoustics expert, Murch sees the sound field as much more a practiced art than a science. "I can keep my head above water in a technical discussion," he says, "sort of catching the drift of what's going on; but as for fixing something, or creating an electronic setup, I just can't do it. I can describe the result that I would like, and I have an intuitive feel for when something's gone wrong, but that's about the extent of it."

Tape recorders first became widely available to the general public in the early 1950s. One New York teenager in particular was instantly fascinated with the new gear and spent much of his free time experimenting with a recorder, a microphone, and a radio. This early interest trailed off after awhile, and it was not until many years later that another medium indirectly brought Murch back to sound. Film was a relatively late discovery for him. As a graduate student at the University of Southern California, he became interested in the medium, and in particular, the specialties of editing and sound mixing. One of his fellow students at U.S.C. was George Lucas.

When Lucas, at the time a protege of Francis Ford Coppola, reached an agreement with Warner Brothers to rework his award-winning student film *THX 1138 4EB* into a feature for Coppola's newly-formed American Zoetrope company, Lucas tapped Murch as his script collaborator (they had co-written the short version) and as designer of the unfamiliar sounds of his totalitarian future. "The hallmark of *THX* is that it is a film set in the future, yet it uses real locations. In sound, the idea was to create an ambience in which part of your perception of this strange world comes from the sound that it makes. The more unusual and evocative those sounds are, the more you have a sense of being in a strange place. One of the subtexts of the movie that guided us as we were working on it was that we wanted a film *from* the future, rather than a film about the future. What you learn about Japan from a Japanese film is different than in a film about Japan made by Americans. There is no attempt made in the Japanese film to explain their customs to you — you just happen to have been watching. Things are going on in the film that obviously have great meaning for the people involved, and on a human level you understand and sympathize, but you have no direct contact with the rituals and events in the film. Yet somehow, the sense you get of Japan from these films is very strong. Almost because it's not explained to you, you have to grapple with it.

"We felt that most science fiction films up until that time condescended to the future. We tried to create a world in which there were events happening, but where you had no way of knowing exactly what was going on. We sort of knew, and we wanted to convey that the events had meaning for the characters, but the only meaning it had for you was in watching the characters respond to their environment." Typical of the unexplained nature of this world is a very brief scene in which *THX* (Robert Duvall) enters a room where old people are sitting listlessly. The sound heard in the room is unmistakably that of air being methodically sucked out and replaced. Were the script to explain this point, the procedure would be identified as one either of euthanasia or possibly rejuvenation. But even though *THX* must understand, it is not explained to us. The event is just a quick digression from the main action, yet presented with the same visual and dramatic conviction that pervades the film. The stratagem works, and we must accept this reality on the film's terms.

On an average film, the sound editor will resort to sound libraries for anywhere up to fifty percent of the sound effects required. Murch prefers not to work that way, but on *THX* it was not even an option. Without access to a library for the great collection of special (and in many cases, never-before-heard in a film) sounds he needed, nearly everything had to be generated from scratch. Every sound in the film — the robots, the jet cars, the White Limbo — is the result of a deliberate choice.

At the time, with the possible exception of HAL 9000, most machine voices had been done with whatever basic filters yielded the desired mechanical tone. Murch and Lucas were well aware of the problems posed by a robot voice, even after a satisfactory effect is arrived at. "We went for the opposite extreme," says Murch, discussing the fair amount of dialog the robot police have in the

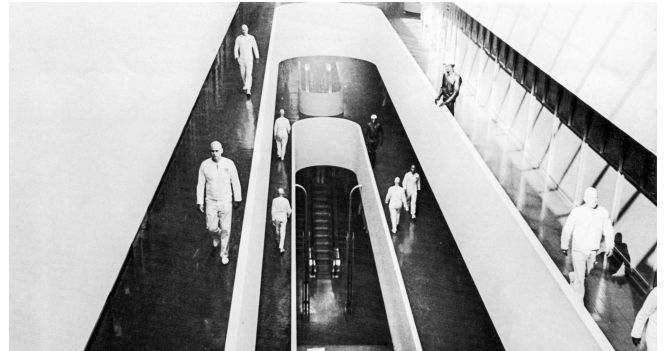
film. “We made their voices extremely unctuous, mellifluous, and without any filtration at all. They talked very much the way you’d expect an over-solicitous funeral director to talk.”

The jet cars figured prominently in the film’s climactic chase scene. Their aural foundation was a single piece of magnetic tape about two feet long — the sound of jet engines as a plane comes in for a landing. The tape was run forwards and backwards, speeded up and slowed down, to produce a series of engine effects for the vehicles, with additional sound detailing added over.

A major setting of the second half of the film, and possibly its largest sound challenge, was the White Limbo — a holding area so vast that it appeared to be endless, where prisoners had no alternative but to conclude that escape was a futile and depressing exercise in getting lost without getting out. “I wanted to create an aural equivalent of that whiteness,” says Murch. “It was a relatively complicated blend of distant calliopes, echo-y voices, and something that we called ‘Exploratorium room tone.’” The latter was a rich mosaic of odd, one-of-a-kind sounds with a most unusual origin. San Francisco’s Palace of Fine Arts has a substantial exhibit area — The Exploratorium — dedicated to what began as high school science projects, plus a general assortment of strange, but functional machines, each with its own unique sound signature. The acoustics of the large, curved hall, with its ceiling three stories above the ground, also contributed to the weird effect. Sounds tended to bounce around and spin. By recording there after hours, when the crowds had gone, Murch was able to capture “an interesting, non-repeatable texture of stuff that you can’t identify.”

Sound work on *THX* took what is probably a roughly representative balance: one year to assemble all the constituent sound elements vs. three weeks of actual mixing. However, Murch did not have the benefit of any assistants on the film. An interesting wrinkle was the decision that Lucas would cut the film at the same time Murch was cutting sound, thereby affording maximum cross-influence of sound and visuals.

THX 1138 was actually Murch’s second feature assignment. Shortly after leaving U.S.C., he worked on the first American Zoetrope production for



George Lucas’ concept for his first feature, THX 1138, was that it would be like a film from the future, rather than about the future. This concept carried over into the sound montages created by Walter Murch for the film, Murch’s primary task was to seek out and record a multitude of never-before-heard sounds that would enhance the production footage, shot in contemporary northern California locations, so that the resulting aural and visual imagery would suggest a subterranean futuristic environment.



George Lucas’ concept for his first feature, THX 1138, was that it would be like a film from the future, rather than about the future. This concept carried over into the sound montages created by Walter Murch for the film, Murch’s primary task was to seek out and record a multitude of never-before-heard sounds that would enhance the production footage, shot in contemporary northern California locations, so that the resulting aural and visual

director Francis Ford Coppola. “*The Rain People* was the first feature film I cut sound on and mixed, so it has a special meaning for me. There was no library material, so I had to develop a lot of the techniques I’d use later on. I had to go out and record everything, or salvage material from the original production tapes. Frequently what happens on a film is that there are perfectly good sound effects for a scene, but they might have occurred in a take that was not good for picture, so the sound doesn’t get transferred and printed. Unless someone goes back and listens to everything carefully, and extracts those sounds, they just get lost and forgotten. *The Rain People* was a situation where I was given a film to do sound on, and where there was no one to tell me what to do. I was off on my own, without any resources other than myself and what I knew or had to learn. It was a very good learning experience.” This also seems to have been the case for George Lucas, observing the film’s production on a Warner Brothers/U.S.C. scholarship and making a documentary on the subject, as the second American Zoetrope feature turned out to be THX 1138.

imagery would suggest a subterranean futuristic environment.

George Lucas’ concept for his first feature, THX 1138, was that it would be like a film from the future, rather than about the future. This concept carried over into the sound montages created by Walter Murch for the film, Murch’s primary task was to seek out and record a multitude of never-before-heard sounds that would enhance the production footage, shot in contemporary northern California locations, so that the resulting aural and visual imagery would suggest a subterranean futuristic environment.

When taking on a film assignment, the first thing Murch does is to compile a list of all the sounds that will be required. Then he tries to reduce the use of library material to a bare minimum. There are several methods of *creating* a new sound, most notably: constructing something, usually mechanical, that when operated makes the sound; juxtaposing or superimposing existing component sounds to form something new; and audio synthesizers. Murch feels the last option is frequently overused, and tends to favor a more natural acoustic approach. With a complete roster of the film’s sounds in hand, the next question becomes, “What is the core sound, or type of sound, of this film?”

“The matrix sound of *American Graffiti* is the music. George and I were very aware of the danger that forty-five songs back-to-back might swamp the film in a way that could make the audience want to reach for some knob and ‘turn off that damn music.’ It’s enjoyable up to a point, but maddening after awhile unless you find some way of modulating it. The forms of modulation I had seen in the past involved changing the level or the equalization. If you wanted it to sound like a car radio was making the music, you would set the fader positions for that kind of balance with the dialog and make it tinny. That didn’t do it for me. There’s another part of the brain that comes into play — an aural perspective. Depending on the clarity of what you hear, it says, ‘Oh, this is important; I’m supposed to listen to this.’ If the sound is less clear, it says, ‘That’s not important, so I won’t listen.’ You still hear it, but mentally, you separate it out and pay attention to what you’re supposed to be paying attention to. We had to find a way to de-focus the music and throw it into a kind of haze. Even when the music was filtered and played low, it still had an immediacy that said, ‘Listen to me! Listen to me!’ You *don’t* want to listen to it at times; you want to hear the cars, or what the person is saying.”

In Murch’s view, a sound should exist within some appropriate context. “I’m extremely interested in the emotion of sound as conveyed through the space it operates in.” It is a conceptual process he

likens to rolling a chicken leg in flour, enroute to becoming fried chicken — “to take a sound and dredge it into the reality it is supposed to be part of.” With the music being the main connecting thread in *American Graffiti*’s nostalgic evocation of high school seniors at the juncture between two eras, it was necessarily a case of striving to eat one’s cake while having it, too — to keep the music an ever-present coloration within scenes, yet avoid its overwhelming the scene’s dramatic content or inducing listener fatigue.

Murch began with a good studio recording of all the music selections, plus Wolfman Jack’s commentary, strung together like one continuous radio show. This was the “dry” track, or Track A, arrived at through a simple two- or three-track mix, independent of the film. Next Murch and director Lucas returned to the gym where the sock hop had been staged, with tape equipment and inexpensive playback speakers. They then re-recorded two additional variations of the original track, taking advantage of the locale’s ambient and reverberant qualities. Standing some thirty to forty feet apart, Murch held the microphone while Lucas held the speaker. Each would move in a gradual arc relative to the other, so that sometimes speaker and microphone were on the same axis, and sometimes off-axis. This became Track B. The procedure was repeated under the same conditions to produce Track C. “B” and “C” — dubbed “airball” tracks — were acoustically the same, except that their pattern shifts did not line up. In the final mix, each track came in on its own fader, but with Track C on a one-sixth second delay to emphasize the random quality and add separation to the axis shift.



Three of the major sound challenges in THX 1138 involved devising representative sounds for the seemingly boundless White Limbo detention area, the jetpropelled autos used in the climactic chase sequence, and the omnipresent robot police. In each case, Murch strove for, and achieved, a sound — or combination of sounds — that was both appropriate and unique.



Three of the major sound challenges in THX 1138 involved devising representative sounds for the seemingly boundless White Limbo detention area, the jetpropelled autos used in the climactic chase sequence, and the omnipresent robot police. In each case, Murch strove for, and achieved, a sound — or combination of sounds — that was both appropriate and unique.



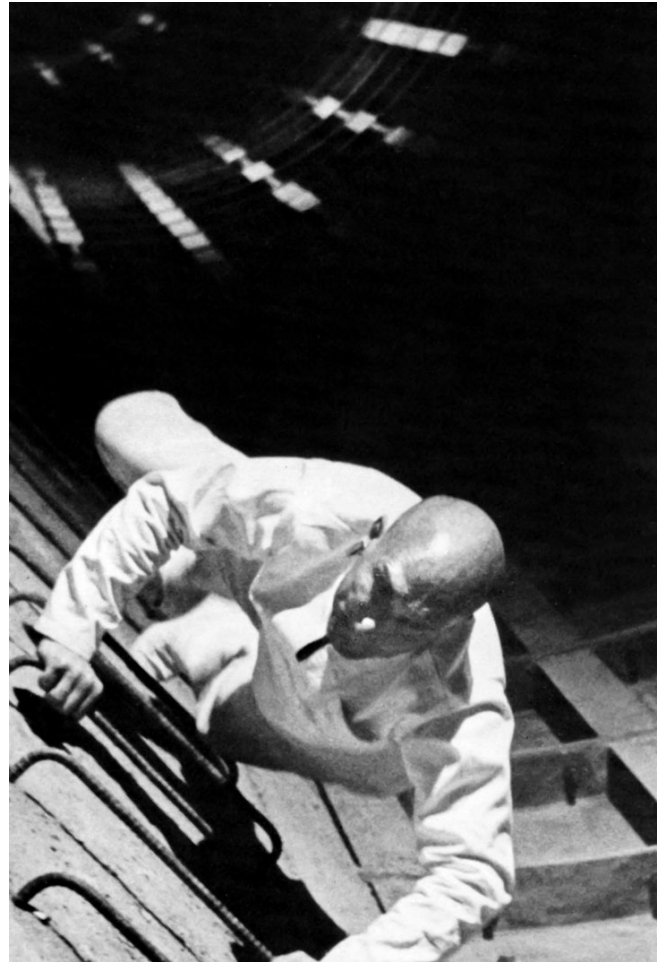
Three of the major sound challenges in THX 1138 involved devising representative sounds for the seemingly boundless White Limbo detention area, the jetpropelled autos used in the climactic chase sequence, and the omnipresent robot police. In each case, Murch strove for, and achieved, a sound — or combination of sounds — that was both appropriate and unique.

(For the remaining locations, most of which were exteriors, this recording process was repeated in a courtyard between two buildings. The resulting tracks could then be manipulated in the mix to fit other scene environments. Background dialog of people only dimly seen, or off-screen, was recorded separately in a space duplicating the “shallow canyon” of the street, with voices echoing off buildings — another naturalistic touch.)

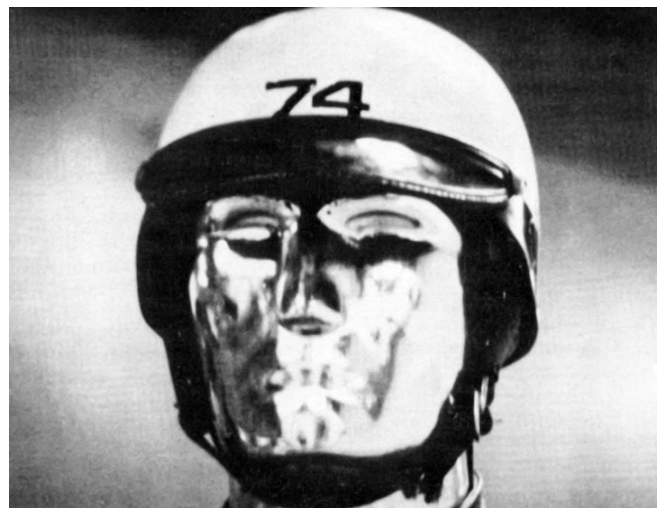
“What this gave you was the ability to bring a sound right up so it leapt out of the screen when the music was being played full and loud for an emotional reason, and then very quickly to change the relationship of those two tracks, fading to something way off that shimmered like the Northern Lights. You didn’t say, ‘They’ve turned the music down,’ because at the same time, someone had begun to talk and you were listening to that. The music was still there, but something about the acoustic envelope surrounding it told your brain, ‘I’m not the really important thing’ — not important intellectually; emotionally, you’re still responding to it.”

This approach proved a solution to the problem of having music and dialog enjoy a peaceful coexistence, even at higher sound levels. “That’s one of the minor miracles of that technique. With the fader/filter technique, to get to a point where you can hear the dialog and listen to the music, the music has to come way down to a level so low it doesn’t interfere with the dialog. But with the wave-shift technique you can actually play both at a fairly loud level. The shifting softens all the edges and keeps them separate and distinct.” Apart from fitting in with the dramatics of a given scene, there was always a good reason for the presence of music, whether the logical source might be a car radio, the P.A. system at a drive-in restaurant, or records playing at the sock hop.

For an art that involves tedious hours behind great banks of hardware, sound has quite a range of intangibles and ample room for philosophical



Three of the major sound challenges in THX 1138 involved devising representative sounds for the seemingly boundless White Limbo detention area, the jetpropelled autos used in the climactic chase sequence, and the omnipresent robot police. In each case, Murch strove for, and achieved, a sound — or combination of sounds — that was both appropriate and unique.



Three of the major sound challenges in THX 1138 involved devising representative sounds for the seemingly

speculation. Take, for example, the proposition that nothing records precisely the way it sounds. Leaving aside the difference between a human ear and a microphone/recorder combination, suppose the object was to record the sound of a factory. The loud machine clamor of a factory stuns the ear's ability to distinguish component sounds, just as it stuns the needles of a recorder. All that remains is a melange of high-volume noise. To put the sound of a factory on tape or film so that it "makes sense" to the ear, it would be necessary to shut everything down, record each machine separately at a practical volume, and then carefully assemble it all in the mix. Observes Murch: "You would make all these little lies that in the end add up to a truth, rather than telling a truth that constitutes a perceptual lie."

boundless White Limbo detention area, the jetpropelled autos used in the climactic chase sequence, and the omnipresent robot police. In each case, Murch strove for, and achieved, a sound — or combination of sounds — that was both appropriate and unique.

The issue of real vs *reel* sound comes rushing to the fore in the matter of two particular sounds that are movie staples: gunshots, and what is commonly called the fist-sock." Over the first ten or twelve years after films began to talk, versions of these sounds were concocted that had a highly dramatic character. "In reality, these things sound much less dramatic. When a person hits another person, there's hardly any sound at all — it's overwhelmed by the rustle of clothing and the grunting of the combatants. The actual sound of fist into flesh is hardly audible. Similarly, gunshots usually sound like someone pounding on a cardboard box. The thing is, those two sounds have a huge emotional content — someone is killing or dying or being beaten to death — and this is extremely important to articulate for the audience." Many of these stock sounds, or later versions patterned after them, are still in use and have taken on the aspect of "reality." The audience is conditioned to accept them as correct, so they represent cases where the truth becomes irrelevant.

Objective truth and emotional truth can come into sharp conflict. "If you stand two feet away from a machine gun and record it, it's so loud you can't have any sense of the fact that this is a machine that deals death, and it's very hot. The sound is more like popping popcorn. When we were very close to machine guns (recording sound effects for *Apocalypse Now*), we equalized an incredible amount of top end into them to try to overcome that, and then added in the jingling brass of the cartridges as they fell out. We really cooked the sound to give the emotional impression of a machine that spews death out at a prodigious rate; whereas the original sound doesn't say any of that at all. Ultimately, who is to say what is the sound? The sound is what's in your mind, not what is on one piece of magnetic tape."

Incorporating all of these factors — the objective "truth" of a sound, the emotional and dramatic



Murch also worked with George Lucas on his second feature, *American Graffiti*. One of his primary assignments for the film was to devise a technique for

qualities it needs to register effectively on film, and the way it behaves within its context — presents a difficult juggling act for the sound mixer. All are important to Murch, and not easily ranked in order. The latter two edge out the first; but whenever possible, he remains a stickler for accuracy. “If somebody closes a door, I want the sound to be from that particular door. Any kind of door sound will usually work, but if it’s a hollow-core door with a Schlage lock in it, that’s the sound I want. It sounds like a hollow-core door because it is a hollow-core door. The fact that nobody imagines it to be otherwise is good. You simply think that it happens, and if you think that it happens, you ascribe it to the reality of the situation. All of those things, on a very subconscious level, tell you something about the story or the characters.”

The list of directors who understand and fully appreciate the contribution sound can make to a film — a contribution potentially approaching the importance of the visual elements — is not all that lengthy. George Lucas and Francis Coppola have long been two of the leading names on that list, and so it is no accident that Walter Murch’s career has been closely linked with theirs. Even back in 1969, when American Zoetrope was first organized, the company’s mixing setup was its nerve center and major capital investment. Working with these two directors, Murch had the opportunity to delve into the subtleties of sound, an extra dimension overlooked in (and perhaps unnecessary for) a majority of films, but one whose effect is very real, even as it operates in areas most of the audience could not readily identify.

modulating the near-nonstop array of early-Sixties rock ‘n’ roll tunes so that dialog and music could coexist at high sound levels — to de-focus the music so that audiences could decipher the dialog, but by some means other than simply lowering its volume. Murch was also responsible for altering the “sound” of the music to correspond logically with its source in the film, whether it be a car radio, the P.A. system at the drive-in restaurant, or the gymnasium sockhop.

Murch also worked with George Lucas on his second feature, *American Graffiti*. One of his primary assignments for the film was to devise a technique for modulating the near-nonstop array of early-Sixties rock ‘n’ roll tunes so that dialog and music could coexist at high sound levels — to de-focus the music so that audiences could decipher the dialog, but by some means other than simply lowering its volume. Murch was also responsible for altering the “sound” of the music to correspond logically with its source in the film, whether it be a car radio, the P.A. system at the drive-in restaurant, or the gymnasium sockhop.

Murch also worked with George Lucas on his second feature, *American Graffiti*. One of his primary assignments for the film was to devise a technique for modulating the near-nonstop array of early-Sixties rock ‘n’ roll tunes so that dialog and music could coexist at high sound levels — to de-focus the music so that audiences could decipher the dialog, but by some means other than simply lowering its volume. Murch was also responsible for altering the “sound” of the music to correspond logically with its source in the film, whether it be a car radio, the P.A. system at the drive-in restaurant, or the gymnasium sockhop.

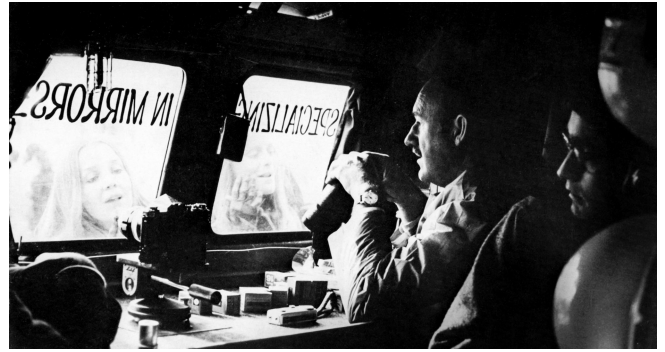
Murch also worked with George Lucas on his second feature, *American Graffiti*. One of his primary assignments for the film was to devise a technique for modulating the near-nonstop array of early-Sixties rock ‘n’ roll tunes so that dialog and music could coexist at high sound levels — to de-focus the music so that audiences could decipher the dialog, but by some means other than simply lowering its volume. Murch was also responsible for altering the “sound” of the music to correspond logically with its source in the film, whether it be a car radio, the P.A. system at the drive-in restaurant, or the gymnasium sockhop.

“Part of the very strong appeal of sound for me,” says Murch, “is that it acts on people horizontally rather than vertically. The fact that your ears are on the side of your head, and your eyes in front — there’s some connection with the way people perceive the world. While you’re looking at the film, watching the action and the characters, you are perceiving those in a conscious, direct, *liminal* way — meanwhile the sound is sneaking in the side door. In a way, it has direct access to parts of the brain that the brain would otherwise defend itself against.

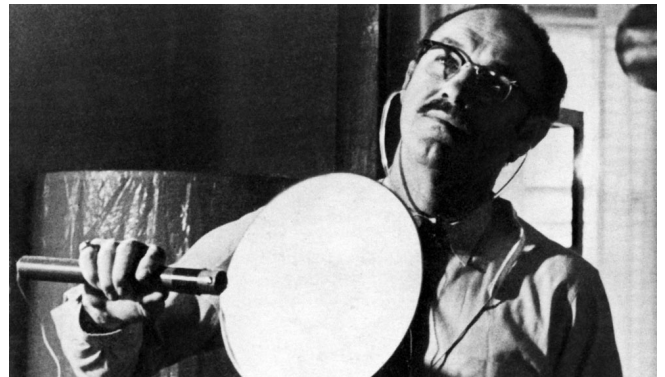
“The last thing you think about is the sound. By the very fact that you don’t suspect the sound as having any effect, it has its effect. Sound’s power is in being invisible. People ascribe its effects to other things. A scene makes them very nervous. If you could pinpoint it somehow, it might have been a squeak in the air conditioner that was driving them nuts. Yet they think about the dramatics of a scene, or the photography, way before they’ll think about any tricks the sound is playing.”

One of the finest films to come out of the Seventies was Francis Ford Coppola’s *The Conversation*. Thematically rich, thought-provoking, more than a little disquieting, its storyline in part also touches, at least indirectly, on pieces of the soundman’s art. “If that film had a sound matrix, it was this tape that the guy made (Gene Hackman as ace electronic-eavesdropper Harry Caul). The tape becomes his obsession, so it gets replayed at various points in the film, for various reasons, in different spaces, and also in different realities. Sometimes it’s totally in his head — you’re listening to the tape, but the way he imagines it. Other times, it’s the sound of the tape, floating down the hall through closed office doors. As he walks, it gets closer and closer, sharper and sharper. What was particularly interesting for me was the manipulation of that one tape through all these realities.”

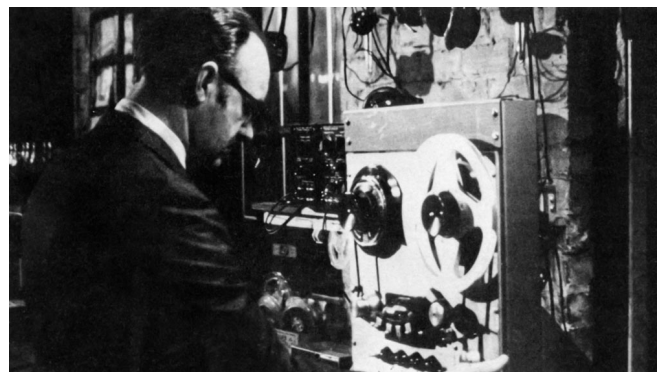
Most of the electronic permutations Caul puts this key piece of tape through, in an effort to extract its vital information, were sound effects Murch created



Francis Ford Coppola’s *The Conversation* concerned itself directly with the soundman’s art in its depiction of a highly proficient, but ethically deficient, electronic eavesdropper. For this picture, Murch enhanced a routine piece of audio tape with numerous synthesizer effects to produce overlapping sound elements which, during the course of the film, were gradually stripped away to reveal the critical overheard dialog upon which the plot hinged.



Francis Ford Coppola’s *The Conversation* concerned itself directly with the soundman’s art in its depiction of a highly proficient, but ethically deficient, electronic eavesdropper. For this picture, Murch enhanced a routine piece of audio tape with numerous synthesizer effects to produce overlapping sound elements which, during the course of the film, were gradually stripped away to reveal the critical overheard dialog upon which the plot hinged.



Francis Ford Coppola’s *The Conversation* concerned itself directly with the soundman’s art in its depiction of a

with synthesizers. But between cutting the film and doing the sound, he had enough to do; the technical depiction of Harry Caul's activities was left to the script and the art director. "In any film dealing with a highly technical area, if you were to show what the technology actually was, it would not be

highly proficient, but ethically deficient, electronic eavesdropper. For this picture, Murch enhanced a routine piece of audio tape with numerous synthesizer effects to produce overlapping sound elements which, during the course of the film, were gradually stripped away to reveal the critical overheard dialog upon which the plot hinged.

comprehensible. What you show is close enough, but simplified. For example, he finally uses a 'black box' device to get rid of the bongo drums. Well, if you were *really* doing that, you'd need a piece of equipment that digitizes the sound. Then you'd have to isolate the waveforms of the bongo drums and subtract them to get what's left. There's no way to get rid of bongo drums with a normal analog filter, because the voice would go, too. Caul was the kind of guy who operated alone, and at the leading edge of that technology. At that leading edge, even in advanced laboratories, the prototype machines don't look the way you'd imagine. When you see something that passes for advanced technology, it's usually advanced *design* technology. The *really* hot pieces of equipment being developed look like they're slapped together with chewing gum and string."

The Conversation's soundtrack has a curious effect on an audience: it is eerie in a nearly unspecifiable way, and seems intricate beyond much real evidence of the fact. The film is scored, sparingly, with a piano that is altered via synthesizer to become progressively more distorted as the story unfolds. But that is only part of the answer. Says Murch: "The sound work on that film is not especially complex in my estimation; I'd like to think it is handled deftly and with a certain amount of depth. But peoples' impression coming away from the film is one of hearing something much more complex than was actually the case. There are two things responsible for that. One of them is that it's a film about sound and a soundman, someone who's always listening. So naturally you tend to look at the world from his point of view. Sounds are very important to him, so they'll be important to you. The other thing is that there are large sections of the film where there's no dialog at all. People hardly speak in the second half of the film. When there is no dialog, peoples' ears become accustomed to a different reality, and they begin listening more closely to the sound effects that are there. Those kinds of sounds are present in any film to some degree, but when there's no dialog you tend not to hear *consciously* the sounds that are in the background. You're not consciously weighing them and trying to integrate them into what the film means. In this film, you have a chance to do that."

The tension between Caul's expertise and what remains of his ethics leads him into wider moral issues. Central to the mystery is the one piece of tape that gets progressively clearer as he subtracts out the sonic "garbage." Coppola cheats a little by hinging his plot twist on slightly different line readings on what was ostensibly one tape. When first decoded, the line is: "He'd kill us if he got the chance." Caul's guilt over the nature of his profession, his ideals about human relationships, and his innate wish to see the young people (Frederic Forrest and Cindy Williams) as likely victims rather than aspiring murderers, predisposes him to hear it that way. As more spying uncovers additional information, Caul must process the tape still further until we learn what it must have said all along: "He'd kill us if he got the chance." The change in emphasis encapsulates problems in truth, perception, responsibility, and signal processing — all in one neat package.

Murch served double duty as editor on *The Conversation*, a feat he repeated (with two co-editors) on *Apocalypse Now*. On *The Conversation*, the transition proved somewhat awkward. “It was a difficult week for me when I had to take off the editor’s hat and put on the sound mixer’s hat. You get so conditioned by cutting the film, and get to understand it so well, that at a certain point you just say: ‘It’s fine. Just release it this way. It doesn’t need any sound.’ But that’s not true. You have to get off the editing axis and get on the sound axis — about a ninety-degree change.”

Murch also worked on both *Godfather* films, which, like *The Rain People*, might be considered more straightforward assignments. However, Murch is not entirely comfortable with that description. “At the time I was doing it, I considered *The Conversation* very straightforward. That’s been the case with most everything I’ve done. There was a problem to be solved, and it seemed the solution was the best way to handle it; so it didn’t seem that unusual to me. *Godfather I* was the first film I ever worked on in Hollywood. The film was mixed at the Goldwyn Studios. It was an exposure to how films are actually done in Hollywood. Until then, I had only worked out of San Francisco. *Godfather II* was organizationally complex because of its great length. Those films use sound, as all of Francis’ films do, but they’re not *The Conversation*.”



Coppola's Apocalypse Now focused harshly on the horrors of war, with visual images that were alternately grimly realistic, surreal and absurdist. Throughout, Murch's objective was to create an accompanying soundtrack that was both objectively accurate and emotionally affecting, yet without drawing undue attention to itself. The awesome result was a complex interweaving of as many as two hundred separate audio tracks of sound information for any given scene..

The next quantum jump in film sound awaited the end of the decade, and Coppola's second tour de force, *Apocalypse Now*. This epic retelling of Joseph Conrad's *Heart of Darkness* in terms of the Vietnam experience offered that rare penultimate challenge and opportunity to demonstrate just what sound can do for a film. *Apocalypse* was in some phase of production over a four-year span, beginning in 1976. Murch came onto the film in 1977 as a film editor, shifting over to sound montage and design the following year. To Coppola's (and cinematographer Vittorio Storaro's) searing, indelible images of war, both real and surreal, Murch added a sense of depth and ultra-reality that greatly enhances their power. More specifically, the accomplishment of Murch and his sound team is an awesome complexity of overlapping aural imagery. Numerous sounds occur simultaneously, often in tandem with music and dialog, yet each occupies its own separate, distinct point of origin, according to the geographical relationships of what we are seeing on the screen.

"The guide words I keep engraved somewhere in the back of my mind are *dense clarity*, or clear density. What I want is something that gives the impression of that density of reality, yet looking into it, it is very clear. It does not fuse into a block, or change into something other than its parts. At the same time, I'm interested in extreme clarity, but I want that clarity to have a weight to it, and that is only achieved by a great number of separate parts set at the right balance."

It was not uncommon to begin with something in the neighborhood of a hundred or two hundred tracks worth of sound information for the mixing of any given section of the *Apocalypse Now* soundtrack, a statistic that in itself tends to make the film unique. All the sound effects to be used were recorded in stereo, thereby doubling the effective options. War films entail a considerable amount of dialog replacement, so every element had to be built up from scratch. There were no atmospheric Vietnam tracks of sufficient quality to be found in sound libraries, and apart from some Swiss documentary footage, no stereo newsfilm of the war at all. "All of the battle background tracks had



Coppola's Apocalypse Now focused harshly on the horrors of war, with visual images that were alternately grimly realistic, surreal and absurdist. Throughout, Murch's objective was to create an accompanying soundtrack that was both objectively accurate and emotionally affecting, yet without drawing undue attention to itself. The awesome result was a complex interweaving of as many as two hundred separate audio tracks of sound information for any given scene..



Coppola's Apocalypse Now focused harshly on the horrors of war, with visual images that were alternately grimly realistic, surreal and absurdist. Throughout, Murch's objective was to create an accompanying soundtrack that was both objectively accurate and emotionally affecting, yet without drawing undue attention to itself. The awesome result was a complex interweaving of as many as two hundred separate audio tracks of sound information for any given scene..

to be recreated gunshot for gunshot,” noted Murch. “That’s a little like making a beach out of grains of sand.”

How can that much sound information be present at one time, yet with each sound-form retaining its own identity and, in many instances, a separate spatial location as well? “Basically, you do a lot of pre-mixing. What that involves, at a very early stage, is looking at the picture and asking, ‘What is the dominant sound here?’ For instance, in the attack on the village, I decided it was the helicopters. Take that concept aside for a moment. Now, ‘What’s the next most constant sound?’ Well, that’s the munitions — off-stage and on-stage gunfire. ‘What’s next?’ Maybe ‘*The Ride of the Valkyries*.’ Then, the Foley effects (such as footsteps and other studio-recorded sounds).

“Within each of those dominant themes — say the helicopters — there are variations: the drone helicopter sound that fills the air like a hive of bees — a constant yet shifting veil of sound; the Huey attack ships’ chop-chop-chop sound; then the Loaches, with a more insect-like ‘nnnnnyowwww’ sound. In the munitions, there’s the Russian munitions — AK-47s and all that stuff; M-16s, mortar whizzes and crumps — a whole series of subtexts.

“We would think of each one of those groupings in the way a conductor would think of the various groupings in an orchestra — from the most dominant to the least. A conductor might look at a piece that he’s going to play and ask himself, ‘Where is most of the sound coming from, and what group of instruments is carrying the main melodic line?’ In that reel, it was the helicopters. They were always there, so loud and pervasive that every sound had to be balanced against *them*. We’d mix them independently, getting them to exist as an aesthetic unity, as though they were the only sounds in the reel. You could sit there and listen to them alone, and they’d make perfect sense. Then, we’d take what we’d done and put that up in the monitor chain.”

No existing mixing facility had the capabilities needed for the *Apocalypse* soundtrack, so Coppola had one custom made at a cost of several hundred thousand dollars. Its central piece of equipment, critical to the task at hand, was an M.C.I. mixing board with a computer memory to keep track of all fader positions over elapsed time. In a sense, this might be considered the sonic equivalent of motion control, as it allows exact repeatability of programmed decisions, while allowing the operator to go back and change one small, specific detail without the risk of damaging everything else or upsetting a delicate balance. The memory’s function is far more useful in the later mixing stages, because it records relative loudness settings, but not all the equalizer or filter stops along the way.

Raw material for pre-mixing — the uncut, unmixed tracks arranged by group — was assembled on the two-inch tape of a 24-track Ampex recorder. This material was then cut and mixed down through the board into its pre-mix form, in units, onto six-track magnetic *film*. “By doing this, you end up with a series of pre-mixes coming to the board that are all thematically distinct. You don’t mix sharp, specific ‘ping’ type sounds with long, low drones, because you may want to suppress the helicopters a bit in the final mix to get more ‘ping.’ If they were mixed together in the pre-mix, you couldn’t do that — they’d be locked together on the same piece of oxide. All these pre-mixes can only be called best guesses. By doing this thematic pre-mixing, you can still revise a lot of earlier decisions.

“I will have already mixed the dialog — you have to understand what people are saying. I’d take the pre-mix of the dialog and put that up in sync with the picture. Listening to the dialog, I would mix the Huey helicopters. I’d take that mix and put it up alongside the dialog, and play those two back while I mixed the Loach helicopters. Then I’d put that up and play those three pre-mixes back while I filled in the drone sounds. Then those four while I did the Russian munitions. Step by step, always referring to everything that went before, the next thing is added. So all of the pre-mixes are internally balanced against each other — from the most basic to the most specific, and in that order.

“Because you’re listening to the helicopters as you do the guns, you’re saying, ‘Right now, the guns are in danger of being swallowed up, so I have to boost them a little bit here.’ Then they have to come down to a more normal level once the helicopter’s gone by. Or ‘Now I have to EQ them a little bit sharper, because the helicopters have a lot of low frequencies.’ Or ‘The helicopter’s moved to the left back, so I’d better put some munitions on the right front.’”

A major factor in achieving clarity in the pre-mixes, despite the number of tracks used in their preparation, was the dbx noise reduction system. Used only up until this stage (tracks had undergone dbx encoding and decoding by the time they passed through the board for pre-mixing), this process offered -20 db of noise suppression, separate from the -10 db of the Dolby system. Like a baton passed from hand to hand in a relay race, Dolby encoding picks up the remaining noise reduction in the final mix, with the decode function taken care of by the Dolby stereo playback system in the theater.

The computer-assisted mixing board could handle no more than about thirty-four tracks at one time. In a case like the helicopters, more than one piece of six-track film could be required to cover a sound group. Six or seven pre-mixes would be fed through the board at the final mix, with the result recorded



Helicopters represented the primary visual and aural motif for the aerial assault on the Viet Cong village. All the helicopter sounds and accompanying effects were recorded separately and then painstakingly mixed over a period of many months. Striving always for realism, Murch procured Vietnam-issue helicopter radio sets, brought the film’s pilots into the studio, and recorded dialog to match the action on screen.



Helicopters represented the primary visual and aural motif for the aerial assault on the Viet Cong village. All the helicopter sounds and accompanying effects were recorded separately and then painstakingly mixed over a period of many months. Striving always for realism, Murch procured Vietnam-issue helicopter radio sets, brought the film’s pilots into the studio, and recorded dialog to match the action on screen.



on the sound master — another piece of six-track film. This formed the basis for transfer to a negative and prints, according to release format: 70mm quintaphonic, 35mm Dolby optical stereo, or regular 35mm monaural.

Apocalypse Now is the only film to date recorded and released in a full quintaphonic stereo format.

Normal four-track stereo presents three tracks in front (behind the screen) with one surround, while six-track stereo presents five in front with one surround. The quintaphonic array used in *Apocalypse Now*), however, has three in front (left, center, and right), another on both the left and right side, and a sixth available track assignable to various locations, but used in *Apocalypse* primarily for low frequency audio signals directed to a special speaker behind the screen. Full quintaphonic stereo is possible only with 70mm equipment, for this custom installation, the theater must have a Dolby decoder and an SA-5 surround adapter. Squarish, no-balcony houses seem to work out best. In addition to the behind-the-screen speakers, four Altec A-8 studio monitors line each wall, and four are placed along the back, with the two on the left back and the two on the right back to be fed the same signal as the speakers on their respective sides.

One might think of the floor plan of this installation in terms of a square. Dialog originates almost exclusively from the front-center speaker. A joystick control used in the final mixing of the film is responsible for the movement of a track from one speaker position to another. Thus, the helicopter sound going from the right front to the left rear of the theater equals a helicopter skimming right over our heads — a very convincing effect, as anyone who has seen the film in this format can attest.

No discussion of the *Apocalypse Now* soundtrack can be complete without mention of the music, another important part of the total effect. In “The End,” The Doors song that haunts the film’s opening minutes, it provides a most apt introduction to the film’s thematic concerns. And in the rather chilling use of Wagner’s “Ride of the Valkyries” — placing us quite enthusiastically among the attacking helicopters — it forever changes our visual associations on hearing

Helicopters represented the primary visual and aural motif for the aerial assault on the Viet Cong village. All the helicopter sounds and accompanying effects were recorded separately and then painstakingly mixed over a period of many months. Striving always for realism, Murch procured Vietnam-issue helicopter radio sets, brought the film’s pilots into the studio, and recorded dialog to match the action on screen.

Murch’s work to date has been linked exclusively to the films of Francis Coppola and George Lucas, two directors of great influence who have a strong appreciation for the subtleties and impact of sound.

Murch’s work to date has been linked exclusively to the films of Francis Coppola and George Lucas, two directors of great influence who have a strong appreciation for the subtleties and impact of sound.



*Academy Award-winner Walter Murch at the audio console custom built for *Apocalypse Now*. The sophisticated mixing board, enhanced with a computer memory system to keep track of all fader positions during the complex mixing process, can handle more than thirty multi-track pre-mixed tapes at once.*

that piece, much as Stanley Kubrick altered our associations for “The Blue Danube Waltz” in 2001: *A Space Odyssey*.

Francis Coppola, who knew Jim Morrison in film school, long intended to make extensive use of The Doors music in this film. Morrison’s lyrics generally kept to the darker side of the human condition and were given tremendous drive by his frenzied delivery and the group’s inventive instrumentals. What changed over the course of production was Murch’s and Coppola’s view of the applicability of songs like “Light My Fire” and “Riders on the Storm.” Explains Murch: “The strange problem was that when we laid them up against the picture, they dealt so exactly with the themes and mood of the film, it was almost funny. Wherever you put them in, they ended up being too close to the scene, and we had to take them out.”

In adapting “The End” — on record, a twelve-minute cut — four minutes were deleted from the middle section. Taken from the same four-track master the record version was derived from, but remixed especially for this incarnation, it seems much more powerful and affecting. “In mixing the music for the film, we put Jim’s voice coming out of the center speaker and the other instruments spread left and right, with a stereo echo coming from the right and left rear. There’s something about that voice all alone in the center that’s very poignant. It’s missing in stereo, where everything’s mixed together.”

The helicopter assault on the Viet Cong village, to the accompaniment of “The Valkyries,” is a sequence of such kinetic impact and cinematic brilliance that it alone is easily worth the price of admission. To find the most stirring recording of this very stirring piece, Murch listened to all the many available renditions. In the Sir Georg Solti/Vienna Philharmonic version, Murch found a rhythm and meter whose dynamism was unsurpassed. “When you spend a long period of time on cutting a sequence *with* its music, it’s like making a stew: the carrots and the beef cook together for so long their flavors intermingle. The longer you edit to it, the more you continue to make refinements and make the picture go with the music. So in the end, it’s a very tight fit.”

At last spring’s Academy Awards, Walter Murch received an Oscar for his soundtrack work on *Apocalypse Now*. Though the award was specifically for this crowning achievement, it can also be taken as recognition of Murch’s notable accomplishments in this key, if little-known, field over the course of some of the milestones in American cinema. Although recently named head of Zoetrope Studios’ sound department, Murch has no definite future plans beyond some script development in which he is presently engaged.

It takes the success of a *Star Wars* or a *Close Encounters* to bring about improvements in film sound at the exhibition level. Largely because of these films, it is now possible to hear stereo sound comparable to good home hi-fi in many neighborhood theaters — with all that this can do to heighten a film’s overall effect. The next big development in film sound is digital technology, where sound is converted into mathematical information and then back into sound to emerge with near-perfect clarity, fidelity, and the total elimination of noise. This is probably five or more years away, but Murch remains concerned about the cost/benefit ratio in modern filmmaking, and the fact that technical developments of the last few years have scarcely been assimilated.

“Things have gotten so expensive that unless there is some kind of breakthrough, I’m afraid there’s a good case for saying film is in its old age. Maybe this is not the best example, but take the

situation with opera and film around the turn of the century. Film at that time was cheap, and nobody thought very much about it. For very little money, you could grab a very large popular audience. And a whole industry was built up overnight, on a relatively unsophisticated technical base. Whereas opera at the same time was so developed, in terms of achieving its effects in music and art direction, that doubling the budget might give you only a two percent improvement. But double the budget in a film at that time and you'd have probably gotten a five hundred percent improvement. Today you can spend \$80 million on a film — terrific special effects and wonderful sound; yet it isn't really *that* different. From a connoisseur's perspective, you could say, 'Yes, I see that the individual frames are blurred exactly the way live action would be, so the model looks more convincing.' But it's going to take an awfully refined palate to appreciate that extra \$40 million. I just tend to feel that the mediums that are the most exciting and innovative are those in which it doesn't take so *much* money to produce an acceptable effect."

Jordan

Fox is a Los Angeles based free lance writer specializing in film-related subjects. A graduate of American University, he received a degree in psychology before discovering his major interest lay in film and writing. He has been published widely in film journals and has worked in documentaries and commercials. In 1975-76, he was assistant producer of The Night Children, a look at the revolving door of the juvenile justice system, which was nominated for an Emmy.



the microcosmic world of Ken Middleham

interview by
Don Shay

The premise itself was not at all uncommon. A celestial phenomenon of unknown origin triggers an unexplained change in one of earth's tiniest and most insignificant creatures — a change first noted in a remote section of the Arizona desert where hordes of consciousness-raised ants are discovered to have formed an apparent alliance against their natural predators and are thereby beginning to subtly disrupt the ecological balance of the region. What was uncommon was the intelligent treatment of the stock genre concept by writer Mayo Simon and director Saul Bass, and some absolutely stunning ant photography by macro-cinematographer Ken Middleham.

Phase IV marked Saul Bass' directorial debut. One of the key names in graphic arts, Bass had made his reputation in film with a series of artfully designed title sequences which had elevated a basically humdrum informational medium to an exciting art form — frequently more impressive than the films they introduced. Bass had long desired to direct his own feature, and when producer Paul Radin approached him on doing a film involving ants, Bass leaped at the opportunity. Mayo Simon was called in and the trio mapped out the basic structure of the film, which Simon then went off and wrote — without any real regard for how the pivotal ant footage would be executed. Once the script was completed, Ken Middleham was brought into the picture.

At the time, Middleham was in charge of the photographic department at the University of California — Riverside. he had had a long-standing interest in macrophotography and had produced a number of award-winning still photographs and filmed documentaries on insects and plant life. He had first worked with Saul Bass on *The Searching Eye*, which Bass had produced for the 1964 New York World's Fair, and had later contributed footage to the apocryphal documentary *The Hellstrom Chronicles*. To accomplish his challenging assignment for Phase IV, Middleham elected to take a year-long leave of absence from the university.

Despite the picture's Arizona setting, economic necessity found Saul Bass and his small cast of human actors shooting location footage in Kenya and studio photography in London. Ken Middleham, meanwhile, was working with his diminutive performers six thousand miles away in his Riverside workshop.

How did you go about getting your ants to perform on camera? Was it a matter of controlling their behavior in some way, or were you just infinitely patient?

I think patience is probably more important in this kind of work. The script was written pretty much the way they wanted, in terms of what they wanted the ants to do. But with something like ants, it's pretty hard to predict just what you're going to be able to get. It's not a question of being able to train them or anything; it's more a matter of trying to manipulate their behavior to get what you're after. You can use gravity, for example. In any given instance, ants will generally move in an upward direction. So if I wanted to control the direction in which the ant was moving, I'd tilt the set in an upward position, and then tilt the camera to compensate for it. There was one scene where Hubbs, the scientist, was bitten by an ant, and he goes running around the laboratory trying to kill it. All the chase scenes were done over in London, but the ant scenes were shot here. They'd shoot the long shots, and I'd do the closeups of the ants. There was one shot where the ant was getting away, and he was supposed to run down the corner of a shelf. Well, there's simply no way you can get an ant to run down; he just won't do it. So what I ended up doing was inverting the camera and the shelf, so that when the ant went up the shelf it looked like he was going down.

Did you have to do a lot of research into ants prior to working on the film?

Well, it was kind of difficult determining what ants to use. One of the original requests was to have one of the principal ants a different color from normal. It was supposed to be some kind of a mediator and Saul wanted it to look entirely different from any of the other ants in the film so it would stand out. They were considering painting it, or putting symbols on it, or something — which would have been very difficult, not only because of the size of the ant, but also because of the texture of the ant itself. It's very difficult to find something that sticks on it. So I decided that this little honeypot ant that I found out in the desert was a good candidate, because although it's naturally yellow in color, it's nearly transparent; and by feeding it colored sugar water I could get it to take on the color of whatever dye I used.

That's how I got the little green ant that you saw in the picture. It was a honeypot ant that I fed with green sugar water. Actually, I colored up some other ones, too — I had a red one, and I think there was a blue one, too — but Saul decided on the green one. The problem with that particular technique was that it made the ant very difficult to photograph, because it would only look green with translucent light. If you shot with reflective light, it would reflect off the surface of the abdomen and look yellow again. So I had to back-light every shot — and in fact, the light would almost have to be directly in back of the ant or the color wouldn't show up. I had to reshoot a lot of stuff because the ant didn't come out green enough.

Who decided if it had to be reshot?

Saul did. I never even saw the footage. About once a week I'd take whatever film I had shot in to Paramount, and they'd ship it over to England. Then Saul would call me up or write a letter and tell me it was either good or bad. But I had no idea of how it was actually turning out. I didn't see any of

it until Saul came back for the first time — about three months later. It was a pretty complicated way to work, because I was never able to see their sets and the colors and textures they were working with over there. We had to communicate via telephone and letters, and I had to work from photographs.

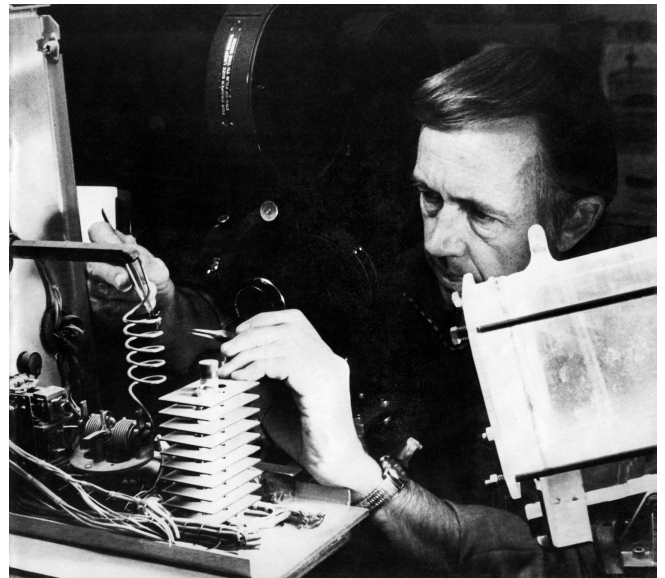
Did you use the same kinds of ants throughout?

No, I used quite a number of different kinds of ants. I used some red harvesters and black harvesters, and some carpenter ants — the large ants who are the soldier-type ants — and the honeypots. Most of them I was able to gather right in my back yard. I've got at least five varieties right here around the house and I know where all the hills are; so if I want a particular kind of ant, I just go out and get it. The honeypots, though, I got from Joshua Tree national Monument. They're a desert ant and I don't have them around here. I do have a type of honeypot here, but it's a smaller ant and it would have been harder to work with. Also it's kind of a brownish color and it wouldn't show up. The large yellow honeypots I used in two aspects. I used them with colored abdomens for the green ant, and then I used them in their natural state as the genetically changed yellow ants, because the other ones I was using earlier in the picture were either black or brown.

Did you build little sets for the ants to run around in, or did you let them dig their own?

No, I built them. The script called for very smooth, structured tunnels — like the ants were intelligent and they were manufacturing these things. I found the best material was this kind of rock cement that you can buy. It's particularly good because you can mix dirt with it — anything actually: soil, sand, rocks, whatever you want — and it'll set it up just as hard as cement. I experimented around with it a little bit and finally came up with a combination of cement and dirt and gravel and pigmented coloring that looked like soil, but was hard enough so the ants couldn't dig in it. If you use a soft material, the ants want to start digging right away and they'll destroy your set on you. Then, to get the various tunnel configurations, I took rubber hose of the right dimension and twisted it through the cement in various ways to get the tunnel shapes I wanted. And I found that just before it sets up and gets real hard, you can run water on it and give it a good brushing and it'll take the cement look away from it and make it look like soil.

There's a scene early in the film where a number of ants appear to have gathered together for a conference of some kind, and they each have different symbols on their heads.



Working with tweezers, macro-cinematographer Ken Middleham positions an ant on a section of the air conditioner interior he constructed for Phase IV. Toiling six thousand miles away from the main production unit in his home workshop, Middleham devoted a full year to photographing the ant footage used throughout the film. The set is positioned on a motorized working surface capable of movement on two axes. In order to keep from roasting his tiny subjects, Middleham had to use bounce lighting, reflective mirrors, and specially designed rigs (right) in which the light passed through six-inch drums of circulating water before striking the set.

That was the hardest thing I've ever done. The idea was that these were the leaders of all these different ant species, and Saul selected a bunch of symbols that he wanted on their heads — circles and squares and triangles and things like that. So I drew those up and photographed them and reduced them down to about one millimeter or less in size. Then I got some very thin copper sheet which I mounted on a wax backing and then coated with photo resist — a chemical light-sensitive material. I exposed the symbols onto this copper plate and then I etched the plate with a copper etcher which dissolved the metal away so that I ended up with a piece of wax with all these little symbols on it. Then I took the wax and dissolved it in naphtha to get just the symbols. It sounds complicated, but that part of it wasn't too bad.

What was bad was trying to get the symbols on the ants' heads. The biggest problem was trying to find something that would stick, because if you look at an ant real close up, it's hairy and kind of waxy. I tried all kinds of glues, but nothing seemed to hold for more than five or ten minutes. I tried Elmer's and Lepage's, all that kind of stuff. Airplane cement I couldn't use because it's toxic — it has acetone in it. Finally I found this five-minute epoxy that did a pretty good job. I could color half the epoxy before putting the hardener in it and get it to match the color of the ant. Then I devised a little V-shaped balsa wood holder with pins in it to hold the ant while I worked with it under a microscope using pointed toothpicks. I'd put this colored epoxy on its head and then put the symbol on and very carefully smooth it out so it looked like part of the head. And I had only five minutes to do it in.

How did you get the ant to stand still for this kind of makeshift lobotomy?

I put it to sleep. I could keep him under with CO2 for about five minutes without killing him. I tell you, it was a really nerveracking experience. Especially since I had to have about six of them together in one of those shots, and even with the epoxy the symbols would fall off in an hour or two because of the ant's natural wax. I worked on this sequence for about a week, and I started breaking out around my eyes. I don't know if it was chemical fumes or eye strain or tension or what, but something was doing it. Everything was very rapid work. I had to do the symbols quickly; otherwise the glue would harden on me. And if I tried to keep the ants under for more than five to seven minutes, it would kill them. Then I had to get all six of them done and get my shooting before the symbols started working loose.

Another problem with that scene was that if you get six dissimilar ants close to one another, they tend to fight. And they weren't supposed to be fighting; they were supposed to be conferring with each other. So I had to keep them pretty groggy and use a lot of cuts. One of the shots called for a closeup of one ant's head, with its symbol, and then a pan to another ant in closeup. I did that with whip pans and then cut in the middle. But try to get them to stand right next to each other and they wouldn't do it.

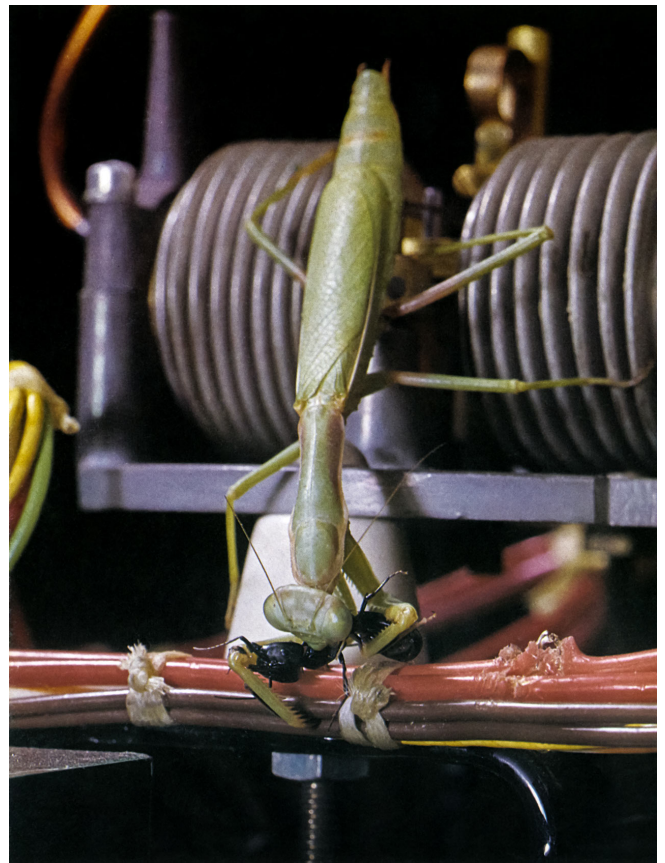
What did you use for the queen ant?

The queen ant wasn't an ant at all. It was manufactured. Saul wanted a very huge queen compared to the other ants — a hundred times bigger, or more. But a queen ant isn't much bigger than regular ants, really — maybe twice as large. So I had to come up with something else for the queen, and what I finally did was I used a tarantula hawk — which is actually a wasp. They call it a tarantula hawk because the female catches and kills a tarantula, buries it, and lays one egg on it. So for every

tarantula hawk you see out in nature, there's a dead tarantula someplace. They're not particularly large wasps, but they're very beautiful insects, with nice yellow antennae, and they're very large compared with the ants. Then, to dress it up a bit, I cast a large artificial abdomen from plastic that fit over the abdomen of the live wasp and made it look really large.

How did you get the wasp to cooperate on that?

Well, the wasp wouldn't tolerate all that mishandling, so I had to anesthetize it when I was fitting it into the plastic abdomen. The hole was made quite small, but could be stretched open to fit over the wasp's abdomen and then hold it tight. Then, when I took the wasp off the CO₂, I had maybe two or three minutes to actually do my photography before it awakened enough to realize that it didn't like its hind end stuck in that plastic. Some of the wasps were more tolerant of the environment than others; some of them I just couldn't work with at all because they'd get very active and try to get away. So to get the footage I needed, it was a matter of doing it over and over and over again.



One of the many complex sequences demanded by the script had an ant fall victim to a praying mantis while trying to sabotage the mobile research laboratory's air conditioning unit.

I used a number of variations on the plastic abdomen idea. On one of the models, I attached an air hose so you could see this live creature sitting there with its back end pulsating. For another series of shots I painted the abdomen with a fluorescent dye and then had an ultraviolet light hooked up on a resistance system so that when the pump expanded the plastic abdomen, the light would brighten up and make it glow. I thought it was pretty interesting, but I guess Saul thought it was a little too much because it didn't make it into the film.

So the egg-laying mechanism was also artificial?

Yes. I built another one of those back end things with a hollow tube running through it so the eggs could be forced down and out the back with another piece of harder plastic. I wasn't real happy with the eggs. I would have preferred using something live that was actually laying eggs, but I couldn't find anything large enough; insect eggs just aren't that big. I looked all over for things, but I finally wound up using rice, which I soaked in gelatin to give it a coating. I worked an awful long time at it, and maybe it looked all right to the audience, but it just didn't look good to me. You just can't fake something like that and expect it to look like nature.

There are a number of scenes in the film where the ants rear up on their hind legs. Is that normal behavior for an ant?

No, that's one of those things that was in the script that I had to work out on my own. I ended up using selsyn motors to get those shots. Selsyn motors come in pairs, One is a control motor and one is a remote; or one's a sender and one's a receiver. They're separate, but there's an electrical interlock so that if you turn one, the other will go in the same direction. I concealed one on the stage with a needle coming out of it, and ran the needle through the thorax of the ant, where the legs are. Glue wouldn't work, because it doesn't stick to the ant, but with the needle the ant would last for maybe a half hour or so — longer if you didn't get any of the vital parts of



Director Saul Bass wanted one of the primary ants to look entirely different from all others. Middleham responded by taking a naturally yellow honeypot ant and feeding it green sugar water until its translucent abdomen assumed the uncustomary color.



In a scene cut from the final film, Middleham had a colony of fire ants "construct" a series of faceted spires. First, he built the crystalline shapes in cement, and then covered them with a like-colored mixture of sugar, starch and

the body. Then by turning the motor slightly, the needle would pivot and the ant would raise up.

butter. Then, using time-lapse photography, he had the ants eat the outer material away.

I used a similar technique for another rough shot.

Near the end of the picture, there's a sequence where Hubbs falls into a pit and thousands and thousands of ants start pouring down on him. Most of that sequence was done on the stage in London, and for that particular shot they didn't use live ants. Instead, they used rice which was dyed black. But just before that begins, there's a shot where a little red ant looks over the edge and turns his head. Well, there's just no way an ant will turn its head; I mean, they simply can't do it. So what I did was I took an ant and severed off the head and then dried the body and mounted it standing up in this little set. Then I took a needle and ran it through some dirt in the set so that the point of it ran up over the body of the ant and extended out where the head would have been. The other end of the needle was connected to one of the selsyn motors. Then, when I was all ready to shoot, I took another ant and severed its head, and then put that head on the end of this needle. When an ant's head is severed, it'll stay alive for a minute or so and the antennae will move and things like that. So right after the head was mounted on the needle, I started the camera and then turned the motor very slightly so the head would look down.

There's another sequence in the film where some of the ants drag their dead comrades through the collapsed tunnels and then line them all up in rows in a kind of burial vault. Could you discuss that sequence?

Well, it wasn't hard to get the dead ants. I just collected a lot of ants and put them in the freezer. That way I could use the same ones over and over. For the live ones I used carpenter ants, because they're really quite aggressive and if you get them excited, they'll grab onto something and hang onto it pretty well. We have two types of carpenter ants in California. One's brown and one's black. The black seems to be the more aggressive, so I used those. For the scenes where they're dragging the dead ants through the caverns, though, I had to help them out a bit. I fastened a thin wire to the dead ant and pulled it along a bit as the carpenter tugged at it. It was pretty tricky, because I wanted to make it look like the ant was doing it; so I had to give him very gentle help, even backtracking a little sometimes so he could walk back with it. We used a lot of cuts there, and the ant was always going behind obstructions, so that helped. Otherwise, I could get him to go just so far and then it would look fake. So I'd have the ant move in between some rocks and the camera would pan with it. Then as the camera panned into the darkness, I'd cut the scene and then start another and pan it into the darkness. By splicing all the dark places together, we were able to get a fairly long run.

For the shots where the ants were lining up their dead, I shot the film in reverse. I'd provoke the carpenter ant and he'd run in and grab onto one of the dead ones and carry it off. By running it in reverse, it looked like he was coming in and leaving it. Fortunately, ants aren't like people in that respect. You can run the footage in reverse and it still looks pretty natural. In fact, I had to do that quite often on this picture.

You mentioned provoking ants. How do you provoke an ant?

I would jab at them with whatever it was I wanted them to grab onto. In this case, I'd hold a dead ant in a pair of tweezers and just jab at the carpenter for a while, and pretty soon he'd attack and grab onto it. Then, if he held onto it for a while and you took it away from him, he'd grab it again. So

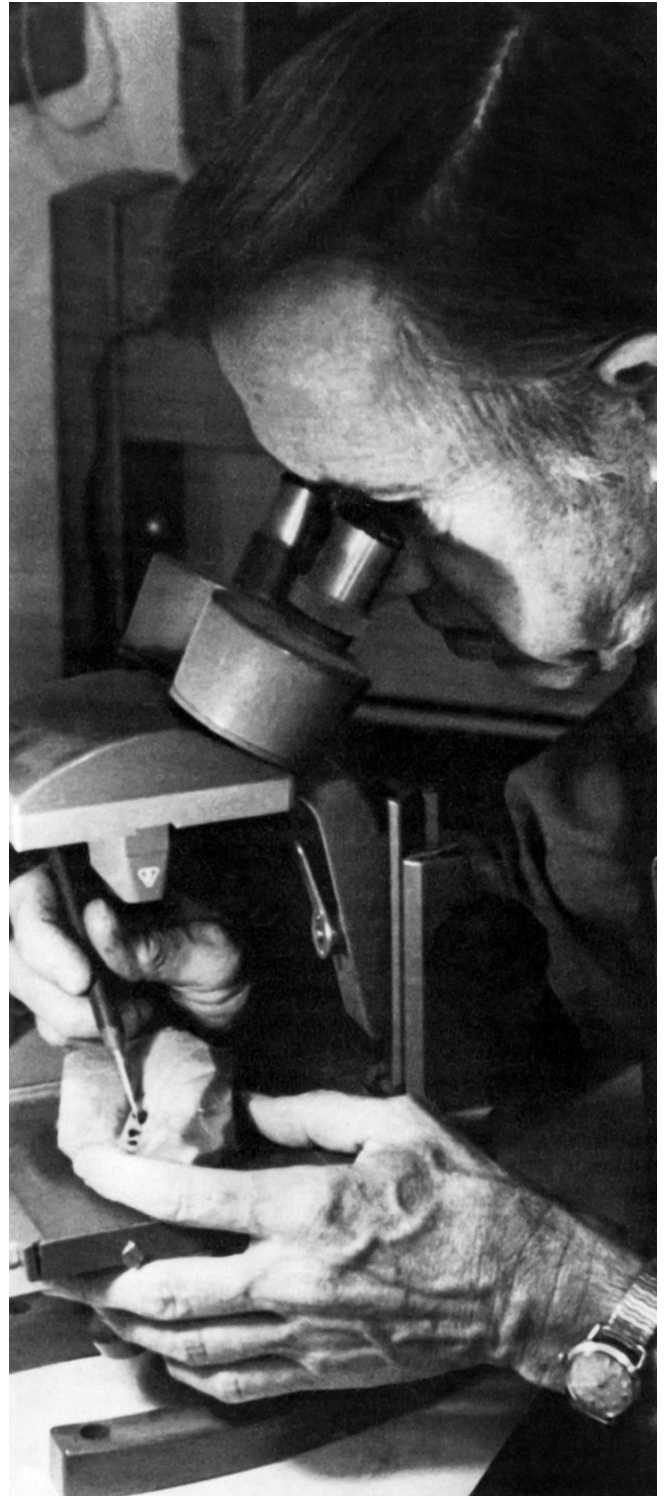
that was the technique I used. I'd get him to hold it and get used to it. Then I'd take it away and start the camera, and he'd come over and grab it again.

One of the most amazing sequences is the one where the ants carry the yellow poison material back to the queen. One ant carries the yellow particle for a ways and then dies; then another ant comes in and picks it up and continues on until it dies; and so on until they get it to the queen and she eats it. Could you go into that a bit?

Well, I used various different things for the poison. For the scenes where it is floating down on the ants and killing them, I had to try and match as closely as possible the action that Saul was shooting. And I remember having quite a lot of trouble getting something that would spray and look like it was material coming down. Finally, I came up with this combination of egg white and yellow coloring, and then I put it on a toothbrush and flicked it so the particles would fall down on the set.

For the shots where the ants are carrying a piece of it back to the queen, though, I used a little piece of yellow plastic foam which I put some honey on, just to make it a little more appealing. Then, I'd provoke one of the ants with it, and get him to carry it a ways. The sets for that particular sequence I built in a little chamber, about eight inches square. It didn't have a top, so I was able to work with it from above. Then, down at the bottom, I had gas jets so I could fill the chamber with CO₂. So once the ant had carried the plastic as far as I wanted him to go, I'd turn on the CO₂ and he'd pass out. Then I'd drain away the gas, replace the anesthetized ant with a frozen dead one — otherwise he might wake up — and then get the next ant to come in and carry the plastic a little bit further before I did the same thing to him. It was extremely time-consuming. I think I spent something like a week on that particular sequence. Like just about everything else in the picture, the final effect was the result of a lot of short cuts. When the queen eats the poison, I switched back to the egg white.

In one of the shots, one of the ants just kind of keels over and dies on top of the yellow crystal, and the next ant has to come in and pull him off.



For a chilling shot in which a number of ants crawl out of three tiny holes in a dead man's palm, Middleham made a cast of his own hand from a flexible plastic material,

That was just a lucky shot. Every once in a while you get one of those, and when you do you go out and celebrate.

Another major sequence of yours took place inside the air conditioner where an ant is trying to sabotage the unit by chewing through a cable and is attacked by a praying mantis. Then another ant attacks the mantis and knocks it onto a high-voltage coil. How did you go about shooting that?

Well, the set I built myself — a couple of aluminum plates and some cables and coils. I had about three or four praying mantises to work with. I'd go down to a filling station nearby at night and collect them. There was a big open field right next to it and they'd be attracted to the fluorescent lights. Then, I had to get them really hungry, because they won't normally eat ants. So I starved them for about three or four days until they were hungry enough to attack just about anything that moved. For the ant that was chewing on the cable, I used another one of my carpenters because of their aggressiveness. It seems to me I colored some agar and Tilled in a section of the cable with that and some honey so the ant would eat it. Then, once I had him working on the cable, I put the praying mantis in up above, and I'd take another ant and provoke him with it to get him ready to attack. Then I'd turn on the camera and let the mantis go after the ant on the cable.

burned in the holes with a soldering iron, and then drove the ants out on cue by filling the holes with an invisible toxic vapor.

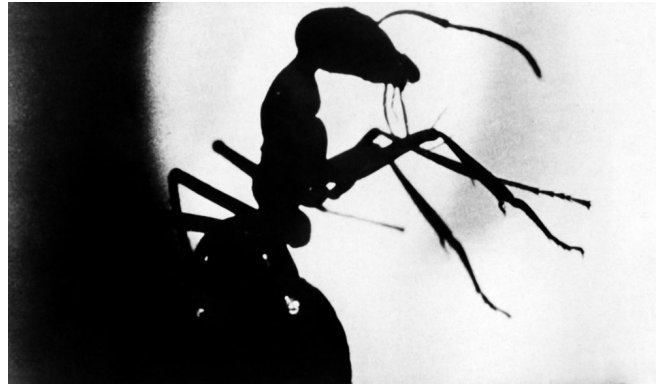
Middleham lines up a shot on a cement block he constructed with numerous tubular passageways for the ants to crawl around in. Small mirrors on articulated arms were used to direct cool light into the holes.

A carpenter ant — the largest variety used in the picture — makes its way through one of the cement passageways.

Geometrically-shaped tunnels, complete with traffic signs, conveyed the desired impression that the Phase IV ants were no ordinary insects.



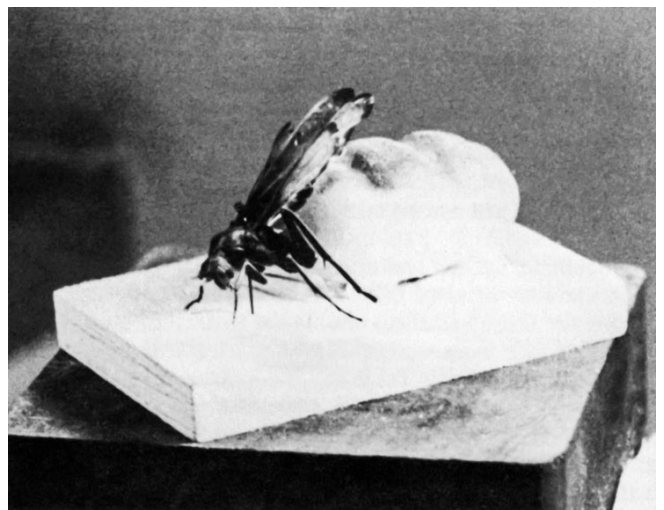
The first indication that the Phase IV ants have been somehow transformed occurs when the ants' natural predators suddenly become their victims instead.



The script called for several shots where ants rear up on their hind legs. To capture this unnatural ant behavior, Middleham had to run a sharp pin out of a small motor, pierce the ant's thorax with it, and then physically rotate the skewered ant remotely.



For a sequence where the ants had to carry their dead comrades to an underground burial vault, Middleham employed carpenter ants because of their aggressive tenacity, and then helped them along a bit with concealed wires.



The giant queen ant (shown here mounted) was actually a wasp with an artificial plastic abdomen.

For the ant that attacks the praying mantis, I used my little green honeypot. That was another shot that I had to do in reverse, because there was no way I could get that ant to run up and grab onto the praying mantis' leg, even though it was severed. So I had to provoke the ant by putting it in his mouth and then taking it away until he would hold onto it for a while. Then, when I thought he was about to release it, I'd start the camera and he'd let go and go back into a dark corner. But by doing it in reverse, it looked as though he came out of the corner and attacked the leg.

The electrocution effect was genuine. I had a 2000-volt transformer set up between a couple of wires so that when the praying mantis fell, it would hit and make contact and just burn right up.

There's a sequence in the film where the scientists use sonic transmissions to disrupt the ants and crumble their dwellings. How did you go about creating those ant-sized earthquake effects?

I built the sets for that particular sequence on a little table that was mounted on rubber shocks. Then I attached a vibrator to the underside of the table; and by running the current through a rheostat, I could regulate the amount of vibration by cutting the power way down until the table vibrated just a very small amount. A lot of that segment was done high-speed — where the tunnels are collapsing — so in those cases I'd have to set the vibration up quite a bit so it would appear to rock like an earthquake. That whole section with the tunnels collapsing in slow motion wasn't in the script. That was just something that I worked out on my own and everybody seemed to like it. For the highspeed shots, I had to use one of my 16mm cameras since I didn't have a high-speed 35. It was shot with fast EF Ektachrome film at about three thousand frames per second. I used strobe lighting to make each frame crystal clear, since with a strobe you have an effective exposure of about a hundred-thousandth of a second for each frame. Then it was post-flashed to reduce the contrast and help the grain structure. I was really pleased with the results. I don't think you can tell it from the rest of the 35mm work in the film.

How did you do the sequences where the ants attack a spider and a rat and devour them?

That was actually done with time-lapse photography. I built an enclosed plastic box with a clear glass window that I could shoot through, and then I built a little set inside it and put in a colony of fire ants. Those fire ants are really quite vicious. Just about anything you put in there they'll attack — and over a period of time, they'll consume it. So I took a wolf spider, freshly-killed, and mounted



The only "ant" footage not produced by Middleham occurred when the scientist Hubbs (Nigel Davenport) falls into a pit-trap and is inundated with hordes of ants. The ants, in this case, were grains of rice dyed black.

it in there. It took them a couple days to completely dismantle it, and I had a timer set up on the camera so that every twelve minutes it would expose a frame of film. The whole scene finally took about ten seconds. I did basically the same thing with the desert rat, but in that case it took them about two weeks to skeletonize it.

I used the time-lapse technique also for a couple of other scenes that didn't make it into the film. One was early on when the green ant is walking through all these tunnels and he stops and looks into a room constructed by the ants, and inside they're manufacturing crystal shapes and geometric forms for some unknown reason. To do that scene, I constructed the finished forms out of cement and dirt with geometric surfaces and facets in them. Then I took sugar and starch and butter and made a paste out of it and colored it the same as the cement. Then I globbed it onto the forms and by working with the fire ants again, I had them come into the chamber and eat all that material away, leaving just the geometric forms. Then later, to tie in with what they were doing outside the laboratory, I had them silver the face of one facet by employing the same technique in reverse. I took aluminum powder, mixed it with powdered sugar and butter, and very carefully smoothed it onto the facet so it looked almost like a silvered surface. Then I let the ants come in and take that material off. In reverse, it looked like they were coming up and putting it on. For some reason, both those scenes were cut out of the film.

Most of the footage you shot had only the ants in it. But there are a number of sequences in the film where both humans and ants are present together on screen at the same time. Did you shoot those ants too?

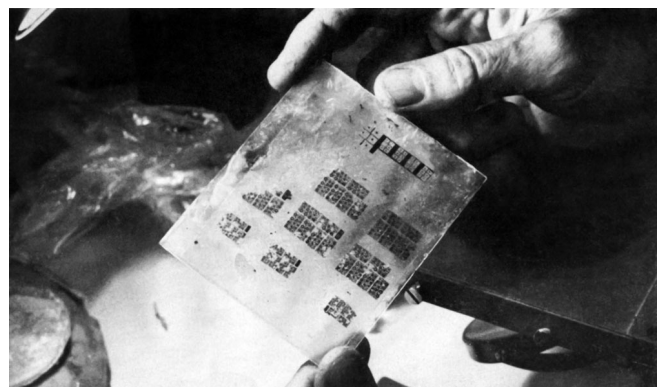
Yes. I shot everything that had to do with the ants in the picture. One of the more interesting combination shots was in the sequence where the green ant crawls up Kendra's body while she's sleeping and then kind of perches on her hand, and you can see the girl's face in the background as she sleeps. I actually used my daughter for most of those scenes. She was about the same age as Lynne Frederick, and there was actually quite a striking resemblance



Several critical scenes involved both humans and ants together on screen at the same time. For the shot where Kendra (Lynne Frederick) awakens to find an ant perched on her hand, Middleham shot an ant on his daughter's hand against a white backdrop. This silhouette footage was then optically bipacked with a shot of Frederick's face in closeup.



Another bi-pack shot had Kendra looking at ants confined in a glass beaker.



Middleham's most difficult task was affixing near-microscopic symbols onto the foreheads of a half dozen

between the two. They sent me the clothing that Kendra had worn on film and I had my daughter wear it. I set up a mat for her in my little shooting

area, and she let an ant crawl around on her for a couple of hours. Again, it was a matter of getting the ant to move in the direction you wanted by elevating certain parts of the body so the ant would go up, and then tilting the camera so it looked like he was going straight. It was mostly a matter of careful lighting and getting very close to the material. In some cases I had to cut away pieces of the fabric and actually overlap the lens to get the impression of being under the clothing.

The shot on the hand I did a couple of ways. On one of them I had the ant coming up on my daughter's hand and her head was out of focus in the back. The one they actually used, though, I shot on her hand against a white background and then Saul bipacked it with a shot of Lynne Frederick. Since the ant was really just a silhouette against white, they could sandwich the two pieces together fairly easily. It was actually a fairly complicated shot, though, because there was racked focus involved. I shot the ant in focus as it crawled up onto the hand and then racked out, and Saul shot Kendra starting out of focus and then racked in; and the two merged together that way. Pretty amazing when you consider the two halves of that shot were done six thousand miles apart. We did another bi-packed shot looking through a glass beaker filled with ants and with Kendra in the background.

Some of the other connecting shots weren't quite so difficult. For the scene where Hubbs is chasing the little ant around the laboratory, I'd just use my own hand instead of his, since that's all that showed. There was one shot that had a closeup of Hubbs' eye looking at the ant real close, and for that I used a friend of mine who had the same color eyes as *Nigel Davenport*.

Let's see, there was also a shot in the truck with the old man where his wife looks up and screams because there's an ant crawling out of his hair. For that I took some white hair and imbedded it in skin-colored plastic, since all you saw was a closeup of the ant and a little bit of hair and skin. I had to move that around a bit while I was shooting to simulate the motion of the truck.

How about the shot where the ants crawl out of the holes in the guy's hand?

For that I made a plaster of Paris cast of my own hand and then I sprayed that with a silicone release material and poured hot mold plastic into it. It comes perfectly clear and you can color it any way you want. After I got the hand, I took a hot soldering iron and made the holes by just melting them in. Then I took some red plastic — the color of blood — and seared it around the edges to make them look like actual holes in the guy's hand.

Was it difficult to get the ants to come out on cue?

Yeah, it was. Once the ants get in a dark place they like it in there and don't want to come out. I ended up having to use a vapor — I don't recall exactly what it was now; either ammonia or acetone, or ethyl acetate maybe — I tried various things and I used the one that worked best. Anyway, it was colorless and heavier than air, so I'd just pour the vapor onto the hand, and as it filled in the holes, the ants would come out to get away from it.

What kinds of equipment do you use in your work?

ants for a sequence in which the leaders of the various desert ant species assemble for a conference.

For most of the ant photography I used 35mm Cineflex cameras, which are actually American-made Arriflexes. They were made during the war because we weren't able to get Arriflex cameras from Germany at the time. For me, one major advantage they have is that the motor goes on the side. The Arriflex motor goes on the bottom, which creates a problem if you're working with closeups. It's much better to have a flat bed so you can get down very close to the table top with it. So I got a bunch of those — in fact, I got six of them at a special surplus-type sale — and I converted four of them into time-lapse cameras and two into shooting cameras. Then I devised my own front end that would accept all the lenses that I have. I can use that special front end with either my 35mm or my 16mm equipment, so it's kind of a direct trade-off. I can put whatever camera I want on my system, because it's the lens that's the important thing — the way you can rack it out and how close you can get to your subject. Another thing you want is the smallest possible camera you can get by with — you're working in cramped spaces and you want to be able to work close to your subject because you're manipulating with your hands. I've got a switch down below that I can operate with my knee that does everything for me. It'll turn the camera and the bright lights on and off and allow me to get in there and work the insects with my two hands while I'm watching through the camera.

What kinds of lenses do you use?

You don't really need special lenses to do macro work, because it's your bellows and rings and so forth that really give you your magnification. So any good-quality lens will do, if it's sharp to begin with. I use the enlarging Ektars quite a lot. They're really good for closeup work. I have a 50mm and a 75- and a 100- in the enlarging Ektars. Then I have a 25mm Taylor-Hobson-Cook which I turn around to shoot real, real close shots, like when I want to fill the screen with an ant's eye or something like that. It's real crisp.

What do you mean by turning it around?

Turning a lens around will sometimes make it sharper; it depends on the lens. A lot of lenses are built so that the sharpest point is actually behind the lens since the film is normally very close to the lens but the subject is far away. Now, when you reverse that process — when you get the subject very close — then the lens tends to fall off in resolution. But if you turn it around, it's used to having things on its backside very close to it and it has better resolution that way. And there's another reason, too. Most lenses are built back in the mount and you can't get your subject close enough to the element to get the magnification you need. If you turn the lens around, you can get very close to the element — which I have to do often since some of the very extreme closeups that I do are within a quarter of an inch from the lens.



A lone ant emerges from the skull of a desert rat. To get a shot where the ants descend upon the rat and devour it, Middleham took a dead rat and put it in amidst a colony of voracious fire ants. Timelapse photography was used to accelerate the skeletonization process.

One very definite problem you have when you get that close is vibration. I discovered this very early in my work when I was doing a film on black widow spiders and I wanted to get some really extreme closeups of the tiny, tiny eggs the widow has in its sac. When I got the film back, I noticed the things were vibrating all over the place. It turns out that it was actually vibration from the camera motor. So I solved that by devising a system where I can put the lens on a bellows and have it attached to the shooting stage rather than the camera. The camera is on a different pedestal entirely and it's got a light interlock so it doesn't ever touch the lens or the stage. So I use that setup quite a lot now for extreme closeup shots.

Was there anything in the Phase IV script that you just could not do?

Yes and no. The script was really written without any regard for how the ant footage was going to be photographed. So there were, of course, some things that were impossible to do. The script would call for one thing, and I'd have to give them something a little bit different. Then we'd talk about it and send letters back and forth until we came up with something that I could give them that would suit their purposes. So there was a lot of compromise involved. I remember for one scene they wanted a huge army of ants underground. They wanted thousands and thousands of ants — which would be difficult to collect, let alone photograph. So on that shot, I ended up putting a mirror in the back of the set so that it looked like there were many, many more ants than there really were. With something like ants, you can only use the script as a guide. Sometimes I was able to give them exactly what they wanted; other times I'm sure what I gave them fell short of what they expected; but then there were times when what I gave them was something considerably better than they had even hoped for. All I could do was go by the script and try my best to get the things that were in it. When I couldn't, I had to come up with something else to take its place. But all these things you have to learn by just getting in there and doing it. You've got an assignment — they tell you what they want; you have to figure out how to do it. And sometimes that can be quite a challenge.

Ken Middleham spent a full year on the exacting ant photography for Phase IV. The picture itself from concept to execution, took nearly three years to complete and had even managed to survive an executive shake-up at the studio. Yet, when it was finished — for a modest \$1.2 million — Paramount seemed uncertain as to what to do with it. It was science fiction, yet only superficially so — and in a time when science fiction was death at the boxoffice. It was horror, yet subtle and restrained — not sufficiently frightening or gruesome for hardcore followers of the genre. Infact, Phase IV did not fit any set pattern at all, which ultimately sealed its doom. For a year and-a-half it sat completed, yet unreleased, in a studio vault. Then, in mid-1975, Paramount dusted it off, designed a lurid and deceptive ad campaign for it ("The Day the Earth Was Turned Into a Cemetery! Ravenous Invaders Controlled by a Terror Out in Space ... Commanded to Annihilate the World! Phase IV — When You Can't Scream Any More!) and then threw it away as the second half of a double bill — with a western, no less. Not surprisingly, it sank without a trace. Only recently has it begun to resurface in science fiction festivals and revival houses.

After Phase IV, Ken Middleham left his post at the University of California to devote himself fully to photographic pursuits. Much of his subsequent work has been used in documentaries and educational films, but he did have two further forays into feature work. In 1975, he produced the elaborate fire-breathing insect footage for William Castle's Bug, and two years later he photographed the man-eating cockroaches featured in Damnation Alley, Neither assignment approached the complexity of his Phase IV work. A major feature-

length documentary to which he devoted two full years of his life, *The Secret Life of Plants*, has been embroiled in financial litigation since its completion in 1978 and only Stevie Wonder's original soundtrack seems to have survived. Ken Middleham is currently engaged in refining his photographic equipment and producing macro segments for the television series, *Those Amazing Animals*.

Phase IV photographs copyright © 1973 by Paramount Pictures Corporation. All rights reserved.



